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ABSTRACT

As one of four volumes in a K-12 series, this teaching guide contains classroom and outdoor activities pertaining to the environment and energy for tenth through twelfth grades. The guide was developed based upon the understanding that environmental education can serve as an instructional umbrella covering many topics (conservation, marine education, city planning, population, etc.) and that it is not a specific subject but an interdisciplinary theme. The activities are organized around four major topics: natural environment, built environment, social institutions and decision making, and energy and environmental resource management. Each section begins with a summary of issues related to that topic followed by a listing of major concepts and their associated objectives. One activity is presented to teach each objective (approximately 40). Objectives correspond with those contained in the California "Course of Study" guide for 1981-84. Each activity provides a brief description, the objective, purpose, time, topics, location, materials, lead-up and preparation procedures, and follow-up activities. Appendices list the sources for the activities, California resource agencies, and teaching materials available from these agencies. In the beginning of the guide, a procedure is outlined for planning an environmental education program. (DC)

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ENVIRONMENTAL EDUCATION GUIDE

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Environmental Education Guide
Volume 4

An Environmental/Energy Education Primer for Grades Ten through Twelve
1981 - 1984

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In cooperation with the California State Department of Education
Wilson Riles, Superintendent of Public Instruction

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Joint Policy Statement
Environmental/Energy Education

California's abundant varied and productive natural resources coupled with a high degree of environmental quality have enabled our citizens to live highly rewarding and productive lives. Successful continuation of a high quality of life for us all depends upon how well we conserve, manage, and utilize energy and natural resources and safeguard our environment.

Wise resource and environmental management involves the intelligent cooperation of governmental resource management agencies, private industry, and concerned and informed citizens acting individually or through their elected and appointed officials.

Intelligent and effective citizen participation in resource and environmental conservation requires knowledge in a number of areas, including the sciences, social sciences, and humanities. It requires the development of skills which enable each person to live in a manner which supports environmental quality. It involves commitment to get involved and work for a better life for all Californians now and in the future.

Our schools play a key role in the development of what amounts to an informed public environment ethic.

Instruction must be provided at all grade levels and in all appropriate subject matter areas. Outdoor learning experiences should be provided and full use should be made of services, materials, and expertise offered by resource management agencies, citizen conservation associations, businesses, industries, and others. Teachers must understand the importance of their role in environmental education, possess the necessary knowledge and skills in this area of instruction, and be provided with adequate instructional materials and equipment.

The Department of Education and the Resources Agency share responsibility for encouraging the development and maintenance of an effective environmental/energy education program for the schools of California. In recognition of this responsibility, we, the Superintendent of Public Instruction and the Secretary for Resources, agree to provide appropriate services, materials, and expertise to the schools and to coordinate our efforts in a statewide program.

We further urge educators and resource management personnel at all levels to work together for the benefit of the most precious resource of all, the youth of California.

Wilson Riles
Superintendent of
Public Instruction

Huey D. Johnson
Secretary for Resources

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The project manager and staff would like to express their appreciation for the professional contributions of the many environmental educators throughout the state.

We owe an enormous debt to our colleagues whose assistance throughout the entire development of this curriculum guide made it possible to move to the next developmental phase. Each phase required a particular kind of expertise and the California environmental education community responded admirably. Rudy Schafer, Environmental/Energy Education Coordinator for the State Department of Education, provided the principal leadership for the development of this Guide. He worked very closely with us throughout the entire project, providing valuable environmental education curriculum materials from California, throughout the United States, and many foreign countries. His support and encouragement were most appreciated.

Esther Railton, Director of Environmental Education at California State University, Hayward, was the principal consultant for the development of the environmental education conceptual framework. Her background, reputation, and experience in environmental education were invaluable to the project team. Upon completion of the environmental education framework, a group of environmental educators from throughout the state were invited to a workshop at the Asilomar Conference Center for the review, critique, and modification of the suggested framework's goals (concepts) and objectives, which were developed under Dr. Railton's guidance. The following people participated at the Asilomar workshop:

Bill Baker
Alameda County Superintendent of Schools
Hayward

Dorothy Bjur
University of Southern California
Los Angeles

Edith Carlston
Pittsburg Unified School District
Pittsburg

Grant Cary
Laurel Ecology Center
Van Nuys

Cheryl Christiansen
Humboldt County Office of Education
Eureka

Jack Davidson, *Los Angeles County Superintendent of Schools*
Downey

Teresa DeBono
Alameda County Superintendent of Schools
Hayward

Bob Flasher
The Oakland Museum
Oakland

Ron Fontaine
Kern High School District
Bakersfield

John Harter
School of Education
University of California, Berkeley

Marlynn Kaake
Lincoln Middle School
Alameda

O. E. Leaf
Department of Conservation
Sacramento

Nat Pearson
Alameda County Superintendent of Schools
Hayward

Gloria Refuerzo
Highlands School
Pittsburg

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California State Department of Education
Sacramento

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California State Department of Education
Sacramento

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Marin County Office of Education
San Rafael

Bruce Stewart
Moss Landing Marine Laboratory
Moss Landing

Vince Vandre
Department of Fish and Game
Sacramento

Debra Voss
Solid Waste Management Board
Sacramento

Randy West
La Vista High School
Orangevale

Molly Whitely
Napa Junction School
Napa

The next major task of the project team was to form a research team to review curriculum programs, guides, and materials from throughout the country to determine what environmental education activities matched the concepts and objectives of the environmental education framework. The following individuals tenaciously pursued this task until activities were matched to each objective of the framework:

Kathryn Slichter
Friends of the Earth
San Francisco

Carolie Sly
Environmental Education Consultant
Berkeley

Alice Watt, Research Assistant
California State University
Hayward

Abby Zurier
Environmental Education Consultant
Palm Springs

Teachers and curriculum experts from all over the state were then selected to review the activities the research team had chosen to determine the best and most appropriate activities for each of the environmental education objectives. There were four such workshops and the following people were involved:

Jeanette Biasotti
Rancho Romero School
Danville

Jerry Bishop
Castro Valley High School
Castro Valley

Lee Boyes
Egling Middle School
Colusa

Maxine Burnworth
Parkside School
Pittsburg

Edith Carlston
Pittsburg Unified School District
Pittsburg

Evelyn Cormier
Brookvale School
Fremont

Sam Dederian
Galileo High School
San Francisco

Linda DeLucchi
Lawrence Hall of Science
Berkeley

Gail Faber
Rancho Romero School
Danville

Bert Felton
Rancho Romero School
Danville

Joe Fontaine
Kern High School
Bakersfield

Phil Gordon
Rancho Arroyo Junior High School
Hayward

Joe Hamilton
New Haven Unified School District
Union City

Gary Heath
Lawrence Hall of Science
Berkeley

Toris Jaeger
Orinda Unified School District
Orinda

Marlynn Kaake
Lincoln Middle School
Alameda

Marcia Batcheller-Kallison
Piedmont Middle School
Piedmont

Margaret Kelley
Coyote Hills Regional Park
Fremont

Sylvia Kendzior
Rancho Arroyo School
Danville

Kathy King
Logan High School
Union City

Dallas LaBlanc
Southwood Junior High School
San Francisco

Carol Libby
Loma Vista School
Vallejo

Rich Lohman
Albany High School
Albany

Helen McKenna
Washington High School
San Francisco

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Unified School District
Sacramento

Nancy Olson
Pittsburg Unified School District
Pittsburg

Erma Owens
Garfield School
Oakland

Lynne Porteous, *Fort Funston*
San Francisco Unified School District
San Francisco

Esther Railton
California State University
Hayward

Gloria Refuerzo
Highlands School
Pittsburg

Karen Reynolds
Oakland Unified School District
Oakland

Melva Rush
Thornton Junior High School
Fremont

Helga Schwab
Earhart School
Alameda

Marilyn Shaver
Bel Air School
Pittsburg

Phyllis Shuck
Olive School
Novato

Sylvia Smith
Pittsburg Unified School District
Pittsburg

Barbara Steinberg
Marin County Office of Education
San Rafael

Ray Watson
Walters Junior High School
Fremont

Randy West
La Vista High School
Orangevale

Molly Whiteley
Napa Junction School
Napa

Bev Wu
Lakeview School
Oakland

When the teacher workshops were completed, we discovered that there was a need to revise and adapt many of the activities to match the objectives more closely. In some cases, the teachers felt that none of the activities they had reviewed was appropriate or acceptable; this required developing original classroom activities. The majority of the writing was done by Larry Rose, San Francisco environmental and energy education consultant, and Carolie Sly. In addition, Carolie had the delicate responsibility of coordinating the efforts of the writing team. The following people also contributed to the writing efforts and to them we owe a debt of gratitude:

Bob Flasher
The Oakland Museum
Oakland

Gary Heath
Lawrence Hall of Science
Berkeley

Marcia Batcheller-Kallison
Piedmont Middle School
Piedmont

Larry Malone
Lawrence Hall of Science
Berkeley

Steve Wilkes
Anna Kirchgater School
Sacramento

Molly Whiteley
Napa Junction School
Napa

Randy West reviewed the California State Resource Agencies materials, selected those that were appropriate for classroom use, and matched those materials to the major areas of concern.

Without Shelle Bolar, Maycelle Elliott, Bonnie Halligan, Marie Perez, and Dorothy Vallerga — secretaries in the Instructional Support Services Unit — who spent endless hours typing this Guide, it never could have become a reality.

The drawings in this Guide are those of Louis LaBrie, Oakland artist. And finally, thanks to John O'Lague and his Publications Services staff, Douglas Arthur, Salvador Cortez, Linda Henderson, and Cindy Price, for editing, designing, and typesetting the Guide.

This Guide has truly been a cooperative effort by the environmental education community; we wish to express our appreciation to all.

August F. Scornaienchi

HISTORICAL DEVELOPMENT OF THE GUIDE

The modern environmental movement which began in the late 1960's has brought about major changes in the ways in which Americans relate to the land, its resources, and to each other. In the early 1970's, the term environmental education came into use as a means of describing an appropriate educational response to this new ethic.

In 1973, the California State Department of Education published a book entitled **Ekistics — A Guide for the Development of an Interdisciplinary Environmental Education Curriculum.** The publication was based on the work of Paul Brandwein, and specified learning experiences in three broad areas in which humans interact with the natural world: in the exchange of matter and energy, through social institutions, and through cultural components and forms. The publication is still in print and considered valuable by many.

In late 1978, a group of representatives of state resource management agencies and the education community got together to discuss environmental education in terms of what had been learned over the years since the development of **Ekistics**, through license plate grants, federal projects, resource agency programs, and other activities. As a result of this meeting, a new set of goals and objectives were developed, and these, in turn, were written into the 1979-81 county superintendents cooperative **Course of Study**.

In that publication, it was observed that environmental education had instructional implications in a number of discipline areas, and specific examples were pointed out in the various subject matter sections.

The resource agency-eduction committee, which had developed the new set of goals and objectives, felt that further work was needed to produce curriculum and supporting materials which would facilitate the infusion of environmental education into the entire K-12 instructional program. A recommendation to this effect was made to the Secretary for Resources who budgeted $150,000 from fiscal 1979-80 environmental license plate funds for this purpose.

After approval by the legislature, the Department of Education called a meeting of key educators including classroom teachers, administrators, teacher educators, resource management agency personnel, and others who reviewed currently available materials, developed a content outline, and otherwise spelled out in some detail what was needed, and how the final product should be organized. It was agreed that input from both educators and resource management personnel was important through every step of the developmental process, and that the emphasis should be on practicality and usability at all levels.

The Department of Education developed a contract based on the recommendations of this ad hoc advisory commitee, and the Alameda County Superintendent of Schools was the successful bidder.

This proved to be a fortunate choice for a number of reasons. The office had a competent staff of people to do the job, was in close contact with the Bay Area education community, and most important, had the contract to produce the 1981-84 **Course of Study**. This latter circumstance proved to be most fortunate because it enabled staff to develop the environmental education material in tandem with the **Course of Study**, with the result that what was produced became a component of an extension of this key state-level publication.

The guide is based on two major premises:

- Environmental education can serve as an instructional umbrella with a great number of topic areas such as energy and conservation, marine education, outdoor school programs, wildlife resources, soil conservation, historical and recreational resource management, city planning, population growth, nature study, and others, may be addressed in a holistic manner.

- That environmental knowledge, skills, and attitudes cut across all subject matter lines at all instructional levels, and, therefore, environmental education should be seen not as a specific and separate subject, but as a theme which should be infused throughout the instructional program at all levels.

In response to the wishes of the ad hoc advisory committee, the Guide has something of practical value for everyone. For curriculum developers and producers of materials, there is a K-12 curriculum outline. Classroom teachers will find nearly 200 sure-fire learning activities selected for their suitability by their colleagues, and access to hundreds more. Administrators will find a plan for getting an appropriate program underway in their schools, resource management agency people will be able to acquaint educators with information regarding their role in resource management, management problems and issues, and materials and services they can provide.

Although publication of this material represents an important milestone in environmental education in California, we must not fall into the trap of believing that the job is completed with its printing and distribution. What happens next in schools and classrooms throughout the state will be the real measure of success for this work, and we are looking to you for your help.

Rudolph J. H. Schafer, Director
Environmental Energy Education
California State Department of Education

INTRODUCTION

A Point of View

The primary goal of environmental education is to develop citizens who are knowledgeable about the environment and involved in working toward a more liveable future. This goal is based on the following assumptions:

- The environment is not only biophysical; it is also aesthetic, economic, social, and political as well.
- Environmental education must promote an environmental ethic where people are not exploiters of the environment but are stewards concerned with the preservation of all life systems.
- Environmental education must reflect a commitment to future generations, not merely perpetuate the values of the past.
- Environmental education is not a subject, but a synthesis of concepts and skills from all disciplines that relate to the environment.
- "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends to do otherwise." (Aldo Leopold)

Organization of the Environmental Education Guide

The purpose of this Guide is to provide teachers with background information, program structure, and activities for environmental education. The Guide actually consists of four volumes: K-3, 4-6, 7-9, and 10-12. Each volume is organized around four major content areas of concern:

1. Natural Environment
2. Built Environment
3. Social Institutions and Decision Making
4. Energy and Environmental Resource Management

These areas are addressed in the following ways:

Issues related to each area of concern are examined in an effort to provide educators with background information. While by no means definitive, these statements are starting points for understanding these complex issues.

A chart, **Matching Objectives to Classroom Activities**, states the instructional objectives under each area of concern and describes, in summary, related activities at the four levels (K-3, 4-6, 7-9, 10-12).

Classroom activities are samples of ways in which a teacher can address the instructional objectives. The activities integrate key stages of cognitive development. Instructional techniques are suggested that promote problem-solving skills, values, and attitudes consistent with our role as stewards of planet earth.

Guidelines for **Planning an Environmental Education Program** are for a principal or curriculum coordinator to follow as s/he helps a group of teachers plan their program.

The appendices give an overview of the California resource agencies. This clarifies the unique role of each agency and how the agencies fit together in a joint effort to manage our state's resources. A list of no-cost and low-cost teaching materials available from these resources is included in this section as well as a directory of California resident outdoor education programs.

PLANNING AN ENVIRONMENTAL EDUCATION PROGRAM

An Interdisciplinary Approach to Environmental Education

The purpose of the **Environmental Education Guide** is to help teachers promote better understanding of the diversities and interdependencies of life systems and nurture the skills involved in decision making. This requires a synthesis of concepts and skills that relate to the environment from **all** subject areas. Environmental education is not treated as a separate, discrete discipline, but as an integration of disciplines that results in new ways of thinking about and behaving toward our environment. We, as educators, are, therefore, faced with the challenge of looking at our curriculum in perhaps a new way — one which allows us to consider the entire curriculum as a system for organizing an environmental education program.

As we integrate concepts from environmental education into the curriculum, we face the danger of fostering a nonsequential, "shotgun" approach to program planning. We hope the Planning Chapter will help guide that process in a way that encourages an individual teacher or a staff to choose concepts, objectives, and activities that are related and built upon each other in a comprehensive sequence.

Overview of Environmental Education Planning

This section of the **Environmental Education Guide** is intended to provide schools with a set of procedures for developing an interdisciplinary environmental education program. These procedures are written primarily for the individual(s) responsible for assisting schools in developing an environmental education program. This may be the principal, a curriculum coordinator, resource specialist, or a teacher. The procedures guide a school staff as they:

- Reach agreement on a working definition of environmental education.
- Review their curriculum for the purpose of identifying current environmental education classroom or school activities.
- Adopt environmental education concepts to infuse into the selected curriculum areas.
- Identify the curriculum area(s) most appropriate for infusing environmental education activities.
- Select and implement environmental education classroom activities.
- Assess the effectiveness of their environmental education program.

These procedures may be followed by an entire staff, or by teachers from a selected department, grade level, or grade cluster (K-3, 4-6, 7-9, 10-12). The entire process can be carried out in approximately three 1½-hour sessions.

Finally, these recommended procedures are not conclusive statements on environmental education curriculum planning. They are intended as **suggestions** and have been successful guidelines for planning other curriculum areas. Also, these procedures are **starting points** for developing an interdisciplinary program; they by no means stand alone as a definitive method toward interdisciplinarity. As these procedures are tried out and revised, it is hoped a useful method will evolve.

Reaching Agreement on Environmental Education Point of View

Session I:	The staff agrees upon a working definition of environmental education, identifies environmental education activities they currently use, and selects major areas of concern to infuse into the curriculum.

The following procedures are designed to help a school faculty come up with a common working definition of environmental education:

- The group leader begins the first session by describing the purpose and the agenda of the session.
- The leader then distributes a copy of the Point-of-View statement from page 6 of the Guide. This statement serves as a starting

point for discussion, "How do we define environmental education?"

- The leader elicits reactions and modifications from the group as they examine the Point-of-View statement. If only minor changes are suggested, participants can note changes on their copies; if extensive changes are suggested, the group leader may want to record on the chalkboard or newsprint.
- The group then attempts to reach agreement on a common Point-of-View statement which reflects their modifications. The leader may facilitate agreement by using a consensus or straw-vote process. (See the Process Glossary for explanations.)

Now that the group has a working definition of environmental education, they are ready to identify elements of environmental education in their existing curriculum.

- The group leader asks each individual to jot down those learning activities that s/he has done, is doing, or plans to do with students that relate to environmental education. These should be noted as briefly as possible, perhaps by title or a short, descriptive phrase.
- As the participants note activities, the group leader places four pieces of newsprint on the wall. Each piece is titled with one of the areas of concern from the Guide: Natural Environment, Built Environment, Social Institutions and Decision Making, and Resource Management.
- After approximately five minutes, the leader asks the group to stop writing and distributes Issues statements of each area of concern (see Guide, pages 19, 41, 59, and 83). These statements will help guide the group as they categorize their activities.
- The leader asks individuals to call out their activities and identify the area of concern that each activity best fits. The leader records responses on the appropriate pieces of newsprint.

The group has compiled a record of ways in which it already teaches about the four areas of concern, as they consider ways to further emphasize environmental education in their curriculum.

- The leader facilitates a discussion of the four areas of concern referring to the Issues statements, as well as the activities listed under each heading.
- The leader distributes Summary of Activities sheets (see pages 21, 43, 63, and 85) and assists the group as they examine the concepts, the objectives, and the activity descriptions under each area of concern.
- After discussion and clarification, the leader asks the group to reconsider its curriculum and determine which of the areas of concern it would like to emphasize in the future. Some members of the group may wish to strengthen or expand on an idea already emphasized; others may wish to tackle a new idea. The leader encourages debate (see debate in the Process Glossary).
- The leader helps the group agree upon which areas it will infuse into the curriculum. This is to be a group decision — the leader may want to use a consensus or rank ordering process to assist the group (see consensus or rank order in the Process Glossary).

The group has now agreed upon a common Point-of-View statement to use as a working definition of environmental education. It has identified currently used curriculum activities, and has also identified the areas of concern it will address in the curriculum.

Selecting Concepts for Your Curriculum

> Session II: The group modifies and selects the concepts under each area of concern that will be infused into the curriculum. Each participant agrees to teach two or three concepts and report back to the group.

The following procedure guides the group as they modify concepts for each selected area of concern:

- The leader describes the purpose and agenda of the session.
- The group forms teams of four to six members. Each team meets around a table (see working in groups of four to six in Process Glossary). Each member has a copy of the Summary of Activities sheet for each of the areas of concern to be infused into the curriculum.

- The leader asks all teams to review concepts, objectives, and activity descriptions for all selected area(s). The leader moves from group to group so that participants have the opportunity to ask questions of clarification.
- The leader then assists the teams as they consider modifications and/or additions.
- After approximately 15 minutes, the leader calls the group back together and elicits proposed changes. These suggestions are recorded on the chalkboard or recorded on newsprint; the leader then helps the group agree on final modifications and/or additions, if any (see consensus or rank order in Process Glossary).

The group now has a satisfactory set of concepts and will select specific concepts to emphasize in their curriculum. They may choose one or several concepts listed under each selected area.

- The group discusses which concepts are most appropriate for its curriculum. They may consider the ages and interests of their students, time constraints they foresee, their own interests and abilities, and the availability of related resources.
- Participants are encouraged to advocate for specific concepts they may think should be included in the curriculum (see advocacy in the Process Glossary).
- After the discussion and advocacy period is over, the leader helps the group reach agreement on which concepts they will include in their curriculum. Once again, the consensus or rank order process may be useful (see Process Glossary).
- This process is repeated for each area of concern the staff has selected.

The group now has a clear picture of the area of concern and related concepts it will infuse into the curriculum. It is now ready to make personal commitments to implement related concepts.

- The group leader prepares the following matrix on the chalkboard or newsprint:

MATRIX I: CHART FOR ELEMENTARY

Teachers' Names and Grade Level	Sam K	Joan 1	Betty 1	Lloyd 2
Selected area of concern and concept				
Natural A	Music	Science	Language Arts	Science
Natural C	Art			Math
Built B	P.E.	Art	Social Sciences	

MATRIX II: CHART FOR SECONDARY

Teacher's Name	Mary	Sam	Tony	Alice
Selected area of concern and concept				
Natural A	U.S. History	World History	Amer. Govt.	Calif. History
Natural C	Calif. History			Calif. History
Built B			Geog.	Calif. History

- Participants have a copy of selected area of concern and concepts. The leader asks participants to identify into which subject area(s) each concept will be infused.
- As participants call out their choices, the leader records the subject area in the appropriate box, or, if by department, the unit or subtopic (see Matrix II).

- When all participants have committed themselves, the leader asks the group to consider the entire matrix. Does the matrix reflect a balanced curriculum, or does it emphasize some subject area and not others? The group may adjust its choices to create a more balanced curriculum.
- Participants then agree to try out one or more activities for the concepts they have each selected and to report back to the group in four to six weeks.
- Optional. Participants gather activities that will teach toward their selected concepts. They use activities from the Guide (pages 21, 43, 63, and 85), suggested activities from Session I, or ideas generated in small groups. The group has modified and selected concepts to infuse into its curriculum. Each participant has then selected concepts to try out with his/her students over a four- to six-week period.

Assessing Progress

> Session III: The group reconvenes to assess progress toward infusing environmental education into the curriculum.

- The group leader describes the purpose and agenda for the session.
- The group divides into teams of four to six; each team meets around a table with two pieces of newsprint.
- Team members identify and record what is going well and why as they try out activities for the selected concepts. The leader moves from group to group, observing and assisting when necessary. Papers are posted.
- Team members then identify and record problems they are having as they try out activities. They list reasons for those problems and post papers.
- The teams are now ready to determine the next step(s) toward infusing environmental education into the curriculum. Given the things that are going well, the problems and the reason for each, what are some next steps? Possibilities may be:

  To continue with current program, with little or no adjustments.
  To gather more activity ideas, based on those that have been successful.
  To focus on solving one or more problems that seem to be major hindrances.
  To try activities from the Guide.
  To gather other resources listed in the Guide (see page 99).
  To schedule an in-service in environmental education.

- The group leader assists the participants as they decide on what specific action to take. S/he helps them outline necessary steps toward that action and divide up responsibilities so that necessary action is taken.
- Dates are set for getting together to review progress. The group has reviewed and assessed its progress toward infusing environmental education into the curriculum; it has also identified any necessary future actions. The procedure outline in Session III can be an ongoing process.

AN INDIVIDUAL APPROACH

The following procedure is designed for an individual teacher who plans to infuse environmental education into his/her curriculum.

1. Refer to the environmental education curriculum matrix on page 13 of the Guide. This matrix will help you select the appropriate subject area(s) and related concepts for teaching environmental education in your classroom.

2. Subject areas are listed across the top of the matrix.

*COURSE OF STUDY GOALS AND OBJECTIVES

ART	BUSINESS EDUCATION	CONSUMER/ HOME EC.	DRAMA/ THEATRE	ENGLISH LANG. ARTS/ READING	FOREIGN LANGUAGE	HEALTH	INDUSTRIAL ED.	MATH	MUSIC	PHYSICAL EDUCATION	SCIENCE	SOCIAL SCIENCE

Choose the subject area(s) into which you will infuse environmental education.

3. Under each subject area you will find numbers which refer to objectives in the **Course of Study**. Locate each numbered objective for the selected subject area(s) by referring to page 15. Read the selected objective. If they are appropriate for your students, refer back to the matrix.

4. You will note that the **Course of Study** objectives are matched to environmental education concepts, which are listed down the left side of the matrix.

NATURAL ENVIRONMENT	A. The natural environment functions according to patterns of established relationships between living and nonliving things.
	B. All species of plants and animals live in habitats and many species exploit more than one habitat in order to meet their needs.
	C. The sun is the ultimate source of energy which all life on earth needs in order to exist.
	D. The environment is being shaped continually by naturally & humanly produced forces which can alter the balance of conditions & lead to changes in the plants & animals which are able to exist there.

Read those environmental education concepts that correlate with the numbered **Course of Study** objectives noted above. If these environmental education concepts are appropriate for your students, you are ready to select objectives and activities for your curriculum.

5. Environmental objectives are listed under the four major areas on the following pages:

Natural Environment, page 20

Built Environment, page 42

Social Institutions and Decision Making, page 62

Energy and Environmental Resource Management, page 84

Refer to the appropriate pages, locate the selected concept(s). Choose one or more objectives under each selected concept.

Review activities which are matched to those objectives. Select activities to try with students (or gather activities from other sources).

After trying out activities, identify what went well and what were some of the problems. Modify your program accordingly.

If you wish to infuse environmental education into other subject areas, repeat these procedures.

ENVIRONMENTAL EDUCATION CONCEPTS

COURSE OF STUDY GOALS AND OBJECTIVES

		ART	BUSINESS EDUCATION	CONSUMER/ HOME EC.	DRAMA/ THEATRE	ENGLISH LANG. ARTS/ READING	FOREIGN LANGUAGE	HEALTH	INDUSTRIAL ED.	MATH	MUSIC	PHYSICAL EDUCATION	SCIENCE	SOCIAL SCIENCE
NATURAL ENVIRONMENT	A. The natural environment functions according to patterns of established relationships between living and nonliving things.												1.2 1.3	
	B. All species of plants and animals live in habitats and many species exploit more than one habitat in order to meet their needs.													
	C. The sun is the ultimate source of energy which all life on earth needs in order to exist.													
	D. The environment is being shaped continually by naturally & humanly produced forces which can alter the balance of conditions & lead to changes in the plants & animals which are able to exist there.	1.1						3.1		3.4		5.3	4.3	1.2
BUILT ENVIRONMENT	A. Built environments depend on resources from the natural environment for survival.			3.1										
	B. The design and maintenance of built environments have both reflected and influenced the values, ethics, and lifestyles of the inhabitants.			3.2 1.2			3.2		4.3			5.4		4.3
	C. Built and natural environments function in similar ways and share many basic needs for survival and growth.							1.4						
SOCIAL INSTITUTIONS AND DECISION MAKING	A. Environmental problems transcend political entities, state and national boundaries & cultural differences.						3.1							4.1
	B. The goals for every society include economic prosperity which is based, in part, on natural resources.		4.4											
	C. Individuals & private groups within our society & independent of the major social, economic, & political decision-making institutions play an important role in developing public awareness of environmental issues & in monitoring public and private activities in relation to the environment.	4.4		3.3	1.2 4.2	6.2		3.3						3.1
	D. Educational institutions & communications media are potential sources for the creation of public awareness of environmental issues.							2.3			4.3			
	E. Environmental law is intended to regulate use of the environment for present & future generations.							2.1 3.2						
RESOURCE MANAGEMENT	A. There are a number of historic & present day models which can be used in developing management programs.													
	B. Conservation is the most immediate way of increasing the real supplies of a natural resource. Conservation practices focus on more efficient uses of natural resources.													
	C. Some resources are renewable & can be maintained so they will provide consistent & continuous supplies of resources as they are needed.								4.2					
	D. To understand the role of the resource agency & its departments in maintaining the productivity of our natural resources into the future.													

PROCESS GLOSSARY

Advocacy is a process that can be used with a group to help discuss the pros and cons of a series of options. The rules are:

- Individuals have 30 seconds to lobby for or against the importance of an option.
- An individual may have additional 30-second periods as long as each period is preceded by someone else's 30 seconds.

Advocacy provides a group with a structure to assist individuals to hear each other. The leader explains the rules, suggesting that individuals name the item they are promoting or not promoting. S/he assists individuals to advocate and monitor the time.

Consensus

Consensus is a process that can be used with a group to reach maximum agreement among its members. Agreement is usually made by a group among a number of options. The leader assisting a group to reach consensus makes sure that everyone understands the options being considered. S/he asks for suggestions as to which options the group wants to take on. These options are noted. S/he points out each option asking the question, "Is there anyone who can't live with the group selecting this option?" If no one objects, the group has reached consensus. If some members object, the leader moves to a next option. This continues until one or two options have only one or two objectors. The leader can ask the one or two what needs to be done to enable them to live with the option. The leader checks out the change with the group.

Curriculum Rating Process

This process may be used to select the curriculum areas in which to infuse environmental education. Individuals are asked to rate the potential for infusion for each of the identified curriculum areas according to this scale.

3-Excellent Potential 2-It's Possible 1-Very Improbable, Forget It

Individuals record their ratings on a chart.

	Person #1	Person #2	Person #3	Person #4
LANGUAGE ARTS	1	1	1	1
SCIENCE	3	3	2	1
SOCIAL SCIENCE	2	3	3	2

Scores are totaled; areas receiving high scores are the better candidates for infusion.

Rank Order

Rank order is a process that takes individual orderings of a set of items and accumulates the ranking to obtain a group ordering. The items to be ordered are labeled by a letter — A, B, C, etc. Each individual is given small 3" x 5" sheets of paper. Each paper is labeled A, B, C, etc. Each person is directed to order his or her papers according to importance. S/he is then asked to number the papers 1, 2, 3, etc.; 1 is the most important.

All the A's, B's, C's, etc., are collected. The numbers on each of the A's are added, then the B's, then the C's, etc. The letter of the option receiving the lowest total number is the most important.

Working in Groups of Four to Six Persons

Rather than work with staff in large group discussion, it may be helpful for groups to work in smaller groups in discussion and decision making. The leader can ask the subgroups to work on tasks of reviewing information, developing options, and forming decisions.Then s/he can collect items from each group and record them on the chalkboard or butcher paper. This helps the group review its comments and reach a decision.

COURSE OF STUDY OBJECTIVES THAT RELATE TO ENVIRONMENTAL CONCEPTS

ART

1.1 To develop awareness of color, shapes, and textures in human-made and natural environments.
4.4 To demonstrate skill in using creative expression as a means of bringing about constructive action to solve social and environmental problems.

BUSINESS EDUCATION

4.4 To develop an understanding of business economics.

CONSUMER/HOME ECONOMICS

1.1 To develop an awareness of personal values in relation to different lifestyles.
1.2 To develop an awareness of personal resources in relation to different lifestyles.
3.1 To develop an understanding about the relationship of housing choices to aesthetic, social, and environmental issues.
3.2 To understand how personal lifestyle choices affect the quality of the environment.
3.3 To understand how community, state, and federal resources are used to provide services within a community.

DRAMA/THEATER

1.2 To develop problem-solving skills through creative drama and improvisation.
4.2 To become aware of the role of drama/theater in influencing public opinion in areas of merchandising, human relations, and politics.

ENGLISH LANGUAGE ARTS/READING

6.2 To develop skills for making critical analyses of written materials and media presentations.

FOREIGN LANGUAGE

3.1 To understand the attitudes and values, customs, traditions, and taboos which make up the culture.
3.2 To become familiar with the environments in which cultural groups have developed.

HEALTH

1.4 To develop strategies for daily living that build self-acceptance and reduce stress and anxiety.
2.1 To understand the causal factors of diseases or other physical disorders and develop strategies for preventing, treating, or controlling these malfunctions.
2.3 To develop skills for evaluating health information, products, and services.
3.1 To understand the relationship between ecological balance in the environment and people's mental, social, and physical well-being.
3.2 To understand the types of resources needed to protect the health of people in local, state, national, and world communities.
3.3 To develop awareness of the personal and community resources that can be used in accident prevention and in meeting emergency situations.

INDUSTRIAL ART

4.2 To develop an awareness of the basic economic structure of our industrial society.
4.3 To develop an awareness of the relationship between environment and industry.

MATHEMATICS

3.4 To develop skills for recognizing and using geometric figures in the environment.

MUSIC

4.3 To understand how cultures and historical periods influence musical styles and forms.

PHYSICAL EDUCATION

5.3 To understand the impact of various recreational activities on the environment.
5.4 To value leisure as a complementary balance to work.

SCIENCE

1.2 To be aware of order and beauty in the natural environment.
1.3 To appreciate and respect all living organisms (including self) and their place in the environment.
4.3 To demonstrate an understanding of the ways in which science and technology affect individual lifestyles and social/cultural development.

SOCIAL SCIENCE

1.2 To understand how societies develop in diverse physical and social settings and meet the needs and desires of their members.
3.1 To understand differences and similarities of the value systems held by different cultural and social groups in the American society.
4.1 To develop an awareness of social change in the past and present and to anticipate future change.
4.3 To participate in social action projects that are of benefit to the community.

Classroom Activities

Natural Environment

The classroom activities in this section are samples of ways in which teachers can address the instructional objectives. These activities help students to understand the connections between the biological and physical worlds, the unique characteristics of habitats, the fundamental importance of the sun, and the effects that the ecosphere has on natural and human forces.

Built Environment

The classroom activities in this section assist students in understanding the dependency of the Built Environment on the Natural Environment, the evolution of the Built Environment and its influence on societal values and stresses, and that the Built and Natural environments are intertwined through an intimate cause/effect relationship.

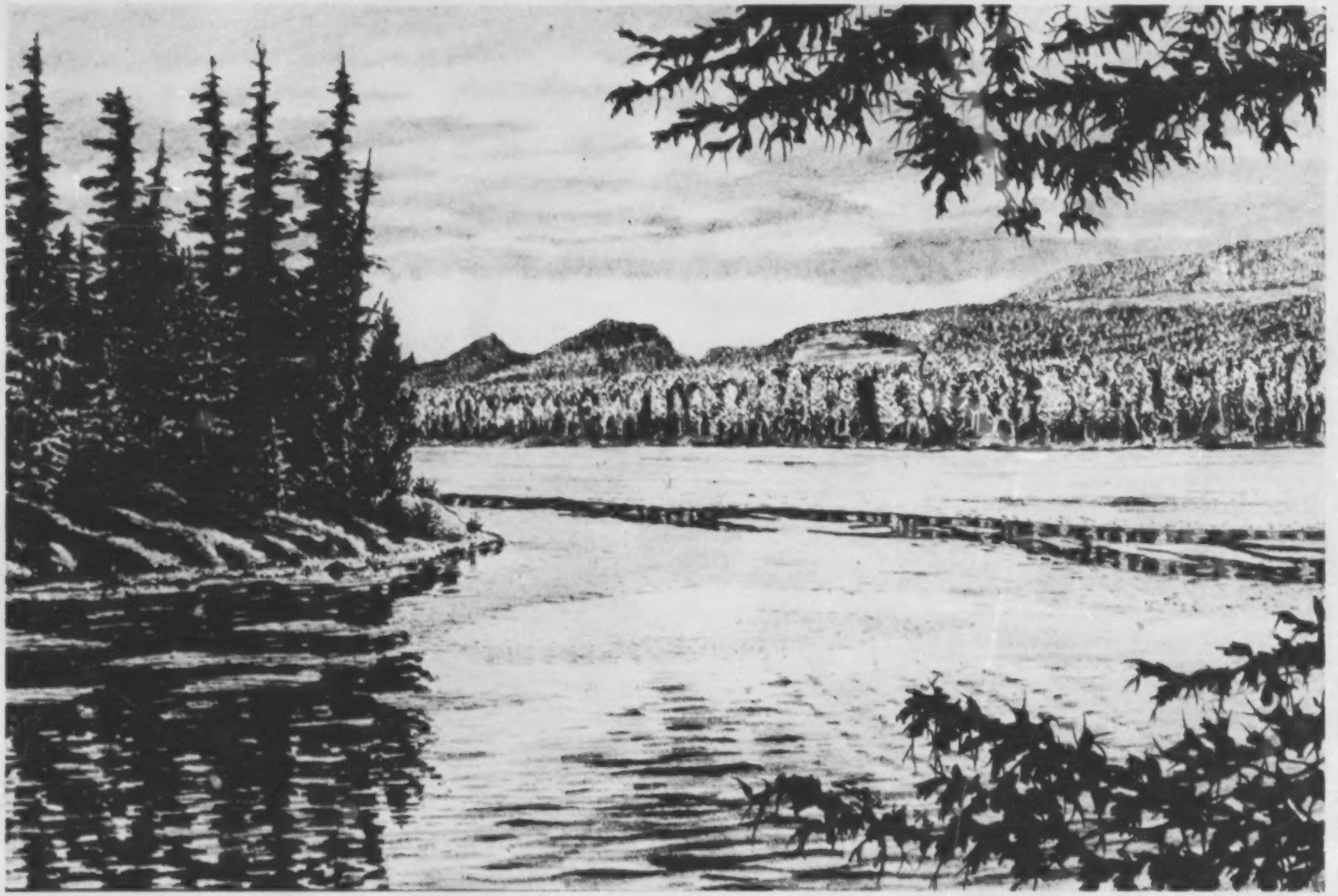
Social Institutions and Decision Making

The classroom activities in this section are samples of ways in which teachers can assist students to understand that environmental problems transcend political entities, state and natural boundaries, and cultural differences, and that individuals, institutions, and private groups within our society play an important role in developing public awareness of environmental issues.

Energy and Environmental Resource Management

The classroom activities in this section are samples of ways in which students can understand the importance of conservation, the costs and benefits of continuously renewing resources, and how we manage our resources in the state.

Natural Environment Activities



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NATURAL ENVIRONMENT

Issues

The part of the Natural Environment of planet earth where all known life systems exist is a relatively thin belt of water, land, and atmosphere called the ecosphere. The ecosphere is comprised of separate, yet interrelated communities of living things called ecosystems, each with its unique mosaic of plants, animals, bacteria, and viruses. The physical and chemical environment of each community determines what can survive there; this intricate web of relationships between the biological and the physical world is fragile and continually changing.

Chemical elements, such as carbon, hydrogen, oxygen, and nitrogen, are essential nutrients for all life forms. They circulate through life systems, continually replenishing the environment and regulating the abundance of life.

Water is a principal means of transport for nutrients traveling throughout the environment. Run-off water from precipitation carries suspended and dissolved elements from the land to the oceans. Radiant energy from the sun lifts them, through evaporation, to be dispersed by wind action. This is the hydrologic cycle, the major transport system for circulating ingredients throughout the ecosphere.

An alteration in the physical or chemical composition of a natural community results in concomitant alterations in the biological compositon. Usually, these changes are gradual — a lake may slowly fill in to become a marshland, then a bog, and climax as a meadow.

Sometimes, however, the process of change may be more sudden and, hence, immediately destructive. A volcanic eruption is an example of a sudden destructive change caused by natural forces. Filling in coastal wetlands for land development is less violent but is an equally destructive change caused by human forces. Agriculture is another human force that affects a natural community, this time by preventing the natural evolution of the land from taking place. Because the tendency to diversify is held in check, agricultural lands become susceptible to disease-carrying bacteria and the invasion of pests. This condition is compounded as crop strains are further refined and farmers plant increasingly specialized monocultures.

Landfill and agricultural practices are two ways that human activity directly affects the ecosphere. Other ways are more insidious, such as industrial pollution, which enters the hydrologic cycle and results in acid rain. It is becoming increasingly apparent that humans must consider the long-range effects of their actions upon the ecosphere before the fragile web of life systems is irrevocably harmed.

Four concepts have been identified to help students understand life systems. The first is concerned with the interconnectedness between the biological and the physical worlds. The second considers the importance of habitats and their unique characteristics. The third stresses the fundamental importance of the sun. The fourth examines natural and human forces which affect the ecosphere.

NATURAL ENVIRONMENT

MAJOR CONCEPTS	OBJECTIVES
A. The natural environment functions according to patterns of established relationships between living and nonliving elements.	1. To understand that all living things play roles and have functions in relation to maintaining and renewing the natural environment. 2. To understand the web that binds together the biological community and the physical world within and between ecosystems in different natural settings. 3. To understand how biological communities of plants, animals, and microorganisms interact within different environments.
B. All species of plants and animals live in habitats and many species exploit more than one habitat in order to meet their needs.	1. To understand that different species of plants and animals depend on specific types of habitats for survival. 2. To understand that each system — water, land, air — contains resources that are important for the maintenance of life.
C. The sun is the ultimate source of energy which all life on earth needs to exist.	1. To understand how the energy radiated by the sun is used on earth to maintain ecological processes. 2. To understand that energy can be stored by plants and converted through natural processes into large scale energy sources, such as petroleum, natural gas, and coal. 3. To understand that energy can neither be created nor destroyed. It is in a constant state of flux.
D. The environment is being shaped continually by natural and human forces which alter the balance of conditions and lead to changes in plant and animal populations.	1. To understand the factors which determine the variety and abundance of life that can be supported within a geographic area. 2. To understand how the biological community of plants, animals, and microorganisms adapt to the environment through changes in genetic composition and population size. 3. To understand how humans manipulate the environment and cause changes in the balance of conditions. 4. To understand the natural forces that continually shape the environment.

NATURAL ENVIRONMENT OBJECTIVES & ACTIVITIES

		K-3	4-6	7-9	10-12
CONCEPT A	1. To understand that all living things play roles and have fuctions in relation to maintaining and renewing the natural environment.	Students take a mini-safari to find out what lives in and around a variety of microhabitats.	Students build a model food pyramid with their bodies.	Students take a census of an outdoor site "job descriptions" for the organisms observed.	Through guided imagery, art, and language arts, students assess the results of the removal of one element from an ecosystem.
	2. To understand the web that binds together the biological community and the physical world within and between ecosystems in different natural settings.	Class sets up a mini-ecosystem in an aquarium.	Students sit in a circle and pass a ball of yarn to form a "web of life."	Students calculate the amount of H_2O released from a leaf through transpiration.	Student committees present mixed media shows illustrating the ecosystem of a nearby area.
	3. To understand how biological communities of plants, animals, and microorganisms interact within different environments.	Students compost their food waste.	Students' lunches are recycled in the classroom by common decomposers.	The decomposing role of sowbugs in the forest ecosystem is studied.	Students collect and arrange specimens in a terrarium.
CONCEPT B	1. To understand that different species of plants and animals depend on specific types of habitats for survival.	Students experiment to determine how plants will grow when subjected to different "types" of water.	Students play a cooperation game modeling systems interaction.	Students take a census of two adjacent natural communities and the ecotone between them.	Students make a mural of the water cycle. They interject disruptions in the environment.
	2. To understand that each system - water, land, air - contains resources that are important for the maintenance of life.	Students hang Vaseline coated paper to collect particles in the air.	Students model a resource balanced ecosystem in a game format.	Students do a worksheet activity on the marine food chain.	Students express opinions on ocean resource issues through debate, language arts, and/or graphics.
CONCEPT C	1. To understand how the energy radiated by the sun is utilized on earth to maintain ecological processes.	Students sprout beans in a sunny area and a dark area to compare beans from each area.	A series of experiments are conducted on the use of sunlight by plants.	Students test uncovered and foil covered coleus leaves for starch production.	Students trace a favorite food back to its ultimate source and trace the use of energy in supplying the food.
	2. To understand that energy can be stored by plants and converted through natural processes into large scale energy sources such as petroleum, natural gas, and coal.	Students are introduced to plants (foods) that give them energy.	Students simulate natural oil deposits by starting a compost pile.	Students prepare and perform a role-play activity on energy transfer.	Teacher leads the class in an extended role-play, modeling the process of fossil fuel generation.
	3. To understand that energy can neither be created nor destroyed—it is in a constant state of flux.	Students participate in a cooking activity to investigate physical and chemical changes.	Students use thermometers to measure heat in classroom.	Students read several personal statements on energy as a stimulus to expanding their own perspectives and writing their own poems.	Students examine the role the sun has played in the culture, past and present.
CONCEPT D	1. To understand the factors which determine the variety and abundance of life that can be supported within a geographic area.	Students investigate different sites in an outdoor area for heat, wind, moisture, etc.	Students experience directly the dramatic results of disruptions in an ecosystem.	Students find the locations outdoors, which are warmest, coolest, brightest, etc. (see level 1).	Through experiments and observation games, students make judgments on probability and desirability of trees in the environment.
	2. To understand how the biological community of plants, animals, and microorganisms adapt to the environment through changes in genetic composition and population size.	The group hunts for colored "worms" in two habitats and compares results.	Students role-play deer in a forest by looking for food, water, and shelter. A rock/paper/scissors game.	Students design animals or plants and explain the reasons for the organisms survival or extinction.	Students research local endangered species, analyze the problem, and prepare action statements.
	3. To understand how humans manipulate the environment and cause changes in the balance of conditions.	Students take a walk to examine the micro-habitats on and near walls.	Students simulate chemicals causing environmental changes and try to control their use and abuse.	Students set up indicators for CO and O^3 in several outside locations.	Students rate environmentally sensitive practices on a values continuum.
	4. To understand the natural forces that continually shape the environment.	A model stream table is set up. Students manipulate water flow and land forms.	Students write stories about, and act out, the natural forces which shape our environment.	Students construct a model of geological evolution — before and after demonstration.	Students assess the possible causes of global glaciation and write a disaster film script.

WITH OR WITHOUT

DESCRIPTION
Through guided imagery, art, and language arts expression, the student assesses the results of the removal of one element from an ecosystem.

OBJECTIVE
A-1. To understand that all living things play roles and have functions in relation to maintaining and renewing the natural environment.

PURPOSE
To show that all parts of an ecosystem are interrelated and have roles in the maintenance and renewal of each other.

Time	Where
1 hour	Classroom
Topics	**Materials**
Ecology, forests, human ecology	Drawing paper for each student and appropriate art supplies for each student

LEAD-UP/PREPARATION
(Optional Guided Imagery)
Teacher leads guided imagery trip to a favorite place in the natural environment. Have students close their eyes and, in their imagination, visit a beautiful natural place (park, mountains, desert, beach, etc.) where they have had good experiences. Once they have chosen the place and in their imaginations have actually experienced the place, give them the following assignment:

"If there are trees in your favorite place, remove them. If there are no trees in your favorite place, put some in." Give plenty of time for students to accomplish these tasks. Before coming back from their imagery trip, be sure to give them the opportunity to put the place back the way it was.

Use the following questions for discussion:
Q: Who would like to tell of his/her experience in this guided imagery exercise?
Q: Was your experience of "tree changing" a good one or a bad one? In what ways?
Q: In what ways could this experience become a real one?
Q: The presence of trees in certain parts of California and the actions of the forest industries with respect to the harvesting of trees for human needs quite often create very heated and emotional issues in California. Has your guided imagery experience shed any light for you on why these issues are so emotional?

ACTIVITY
Step 1
Provide each student with a sheet of drawing paper. Ask each student to divide his/her paper in half. At the top of the left-hand half have them write the word WITH and on the top of the right-hand half have them write the word WITHOUT. Their assignment is to draw one of the following areas WITH and WITHOUT trees on the appropriate half of their paper:

- Golf course
- School grounds
- Campsite
- Playground
- Street on which they live
- Place of business
- Park
- Mountain range
- Wilderness area
- Desert
- Beach

Step 2
When they are finished drawing, have students create a poem, bumper sticker, slogan, or advertising jingle to indicate their personal feelings about the difference between the two halves, and write it directly on their drawings.

Step 3
Share with the class and display the drawings.

Step 4
Discuss:
Q: How do trees help to maintain the natural environment?
Q: What role do they play in renewing the natural environment?
Q: Trees are often called "renewable natural resources." What is meant by this phrase? What other natural resources are renewable? What natural resources are nonrenewable?

FOLLOW-UP

Choose some other part of the environment to remove or add. Over the period of a few days or weeks, the teacher may remove the plants from the classroom or add some plants without the knowledge of the class. Watch for class reactions, and discuss the value of living things in the environment to our well being.
Q: Why do plants in our living spaces generally enhance the quality of life?

Adapted from *Project Learning Tree*

INTERDEPENDENCE IS THE MESSAGE

DESCRIPTION

Student committees present to the rest of the class mixed media shows illustrating the ecosystem of a nearby area. The presentations are critiqued according to selected criteria.

OBJECTIVE

A-2. To understand the web that binds together the biological community and the physical world within and between ecosystems in different natural settings.

PURPOSE

To develop the concept of ecosystems. An ecosystem is a community of living and nonliving things.

Time	**Where**
15 minutes to set up 3-5 hours, both in-class and as homework	Classroom, home
Topics	**Materials**
Ecosystem, interdependence	Art materials, audiovisual equipment at student request (see Activity Step #1)

LEAD-UP/PREPARATION

A brief discussion of media and mixed-media presentations should precede the giving of the assignment below.
Q: What is meant by the term media? How many "mediums" (show that the word media is the plural of medium) have you experienced in the last few days (television, radio, records, billboard)?
List the students' answers on the board.
Q: If you wanted to inform or influence a large group of people, what medium would you choose to use? Is any one medium more powerful than the others?

continued

ACTIVITY

Step 1

Divide your class into several small groups or committees. The assignment for each is to present a mixed media presentation about a local park, vacant lot, nature area, farm, wood lot, school grounds, etc. The presentation could have as its theme "The _____Is a Dynamic Community." Define "dynamic" in terms of movement, change, and interaction. The students should choose the media and format of their presentation. Each committee should be given as much time as it needs for its final presentation. Tell the committee that the rest of the class will be observing and critiquing the show just as a theater or music critic observes and criticizes. Suggestions for media/formats include the use of posters, tape recordings, music, poetry, skits, and slide or photo shows.

Step 2

Schedule times for the presentations.

Step 3

During the presentations the rest of the class should become critics and make judgments, to be shared later, based on the following:

Q: How effectively was the message communicated? How well done was the presentation?

Q: How accurate was the information presented?

Q: How appropriate was the medium to the message?

FOLLOW-UP

1. Ask your students to design an ad campaign for the beautification of the school grounds. The theme could be "Students Are Part of Our Ecosystem."
2. Have a think-in to design environmental bumper stickers.
3. Have your students write a 30-second commercial on an environmental issue of local concern.

BUILD AN ECOSYSTEM

DESCRIPTION

Students collect specimens from a nearby natural area, or purchase specimens representing a natural area, arrange the specimens in a terrarium, and observe changes.

OBJECTIVE

A-3. To understand how biological communities of plants, animals, and microorganisms interact within different environments.

PURPOSE

Students will be able to design and build a terrarium which simulates a real plant and animal community.

Time	Where
Ongoing term project	Classroom, local field trip
Topics	**Materials**
Ecosystem, survival	Large fish bowl or plastic glass container, pebbles, rocks; living plants and animals from field trip collection or from store; soil, ground litter (leaves and other natural debris)

LEAD-UP/PREPARATION

Take the class on a field trip to observe a natural ecosystem in your community. Ask students to observe the habitat and make careful notes on their observations.

Have the students carefully collect samples of the plant life along with ground litter, soil samples, and perhaps some of the invertebrate life forms (insects, worms, etc.) which live in the habitat. Students should choose small specimens and make sure to extract carefully the root systems with as little damage as possible. Plants should never be taken unless the individual is one of many in the area. Some areas prohibit

the taking of any specimens at all. The ideal collecting locality is one scheduled to be cleared for construction, or one that will soon be turned to agricultural or logging use.

ACTIVITY

Step 1

Terrarium construction. Cover the bottom of a large see-through container (fish bowl, plastic container, commercial terrarium) with a one-inch (2.5 cm) layer of pebbles and/or charcoal, covered in turn with a two inch (5 cm) layer of collected soil. Make a hole large enough for the root system of each plant, fill it with water, and put in the root ball. Fill the hole so that the soil level on the plant is the same as it was in the natural environment. Do not overcrowd the terrarium. It is better to have a few plants than an overcrowded situation since plants need room to grow.

Step 2

Every three or four days the students should observe the terrarium and note what is happening there. Students may wish to alter the terrarium conditions by underwatering, adding a little salt, limiting available light, etc. Discuss the effects of each of these interferences.

Q: Can such interferences happen in nature? How?

FOLLOW-UP

Construct terraria which model ecosystems *not* characteristic of your area by purchasing samples or taking long distance collecting trips.

With good luck and careful management, it is possible to bring a terrarium to equilibrium—that is, to such a state that nothing need be added over long periods of time (except some water)—yet all of the plants and other life forms in the system have all of their needs satisfied. Discuss with your students the concept of ecosystem equilibrium.

Q: List all of the organisms in the terrarium. What does each need for survival? How are each of these needs met?

Q: What could go wrong? Are there examples you can name from nature to parallel these misadventures? (Too much watering is somewhat equivalent to a flood situation.)

Q: Can there be too much of a good thing, that is, could one of the plants destroy the others by its growth rate or by having its particular needs met too well?

Q: Do some plants have ways of destroying others?

Q: Are the plants in competition with one another for nutrients, light, water, room, etc.? What are the consequences in nature of such competition? How do plants which are "weaker" survive in nature?

Q: What happens if there are too many worms?

Q: Do populations (number of individuals of a given species) adjust to the resources available to them? Has your terrarium demonstrated this?

Adapted from *Project Learning Tree*

WATER, WATER EVERYWHERE

DESCRIPTION
Students will make a mural of the water cycle. They will interject natural and human caused disruptions in the environment.

OBJECTIVE
B-1. To understand that different species of plants and animals depend on specific types of habitats for survival.

PURPOSE
To outline cycles in nature and show the effects of interruptions, both natural and human-made, in the cycle.

Time	Where
2 hour-long sessions	Classroom
Topics	**Materials**
Water, environmental quality, natural disasters	Butcher paper, magic markers

LEAD-UP/PREPARATION
The concept of cyclicity may be discussed by brainstorming a list of natural and human-made cycles. Some examples might be the oxygen cycle, the cycle of the seasons, the sports cycle (summer baseball, fall football, winter hockey, etc.). Ask your students to express their personal relationship with natural cycles in some self-expressive manner; e.g., poetry, drawing, prose form.

Haiku on the Cycle of the Seasons

In spring the forest
Hears my footsteps
"Come forth, be with us!"

Other summers will
Come to bless the road I take;
This land of ours smiles.

The music goes on
The leaves I knew have fallen.
They cover my way.

Sitting in winter
My memories keep me warm.
The remembered fire.

ACTIVITY

Step 1
Divide your class into small groups. The assignment for each group is to generate a list of all the ways humans use water. For example, water is used by farm animals to drink, by farmers for irrigation, for household use, for industrial use, etc.

Step 2
Have your students list water *sources*, for example, wells, streams, the sea, etc.

Step 3
Have your students generate a chart of the water cycle whereby they can trace the movement of a quantity of water from a source to a use and then back to a source. Have each small group share its chart of uses and sources; then allow time for groups to add to their charts.

Note
Steps 1-3 may be eliminated by providing the class with prepared diagrams of the water cycle.

Step 4
Have each small group outline *five* natural disasters which could disrupt the cycle. Have them indicate on their water cycle diagrams the location of each disaster. Repeat, using human-caused disasters.

Q: What can we do to prevent human-caused disasters outlined by the class?

Q: What can we do to prepare for such disasters both on societal and individual levels?

Q: After a disaster occurs (choose one as an example), how much time would be necessary to restore the cycle? What would be the consequences of this time lag?

Step 5
Discuss: Have the groups list five water "rights" and five water "wrongs" for sharing with the rest of the class. (Examples—Water "right": to turn off water faucet when not in use. Water "wrong": to take an unnecessarily long shower.)

FOLLOW-UP

Take a trip to a local reservoir or water station. Find out what is being done to prepare for emergencies. Have each student write a short story or a movie script entitled "The Day the Water Cycle Stopped Turning."

Have your class design a set of bumper stickers on water preparedness.

Adapted from *Project Learning Tree* and *Captain Hydro* (EBMUD); poem by Larry Rose

THE ISSUE IS THE OCEAN

DESCRIPTION

Students express opinions on ocean resource issues through debate, language arts expression, and/or graphic arts.

OBJECTIVE

B-2. To understand that each system—water, land, air—contains resources that are important for the maintenance of life.

PURPOSE

To have students analyze the critical economic issues involving the care and maintenance of our oceans.

Time	Where
Variable—2 hour minimum	Classroom
Topics	**Materials**
Oceans, economics, environmental legislation	1 copy of "Issues," for each student

LEAD-UP/PREPARATION

Prepare a copy of the "Issues" paragraphs for each student and distribute them.

ACTIVITY

Step 1
Read the paragraphs below out loud in class.

Step 2
Tell the students that they are to pick one of the "Issues" presented in the paragraphs and prepare one or more of the following on the subject:

1. A debate between the forces concerned with the issue
2. A poem or short story with a point of view about the issue
3. A drawing, collage, painting, or poster with a point of view on the issue chosen

continued

Step 3

Have the students share their work. Hold the debate, listen to the writings, display the graphics.

ISSUES

There are many issues in oceanography that are being debated even more heatedly than the potential extinction of whales. The issues include the following topics:

1. For most of our history, we have thought of the oceans in terms of an economic and political concept sometimes known as "freedom of the seas." Basically, according to this point of view, the oceans (and the fish and mineral resources in them) are common property; they belong to everyone. Fish are "free": when we buy them in the market, we are paying for only the fisherman's labor in catching them.
   This sea-as-a-commons theory is based on certain assumptions: that the oceans are too large to turn into property, that they are infinitely pure, and that their resources are unlimited.
   Now, with the exception of some people who defend the notion of freedom and resist restriction at any cost, most theorists are at least questioning the idea of freedom of the seas—if they are not shouting that it is dead wrong. The question remains: Who owns what?
2. Current theory has it that improved fishing technology and increased population necessitate some international regulation of marine resources. The debate includes problems of enforcement. There are laws to prevent indiscriminate ocean dumping, for example, but how can they be enforced? The same problem arises when we try to allocate mineral resources, police whalers, or protect dolphins.
3. How can we meet our oil needs? Should our ports be developed to accommodate large tankers, or should offshore facilities with pipelines to shore be developed? How can we balance the need for the oil reserves off the U.S. coasts and the need to prevent potential damage to the environment and to fisheries?
4. Each nation has been given a 200-mile extension of its borders into the sea. What will happen where jurisdictions overlap? What will be the fate of states that have no seacoasts?

FOLLOW-UP

Discuss: In what ways are the oceans our last great resource reserve? (What is out there that could be beneficial to us?)

What is the principle of sovereignty? How are sovereignty and freedom of the high seas no longer adequate in controlling exploitation of the oceans?

What part of the oceans should be given to states that have no ocean borders, called "geographically disadvantaged states"? How will these states reach their share if they have to pass through water "owned" by an enemy?

Adapted from *Marine Studies Idea Book*

BIOGRAPHY OF A FAVORITE FOOD

DESCRIPTION
Students trace a favorite food back to its ultimate source (plant photosynthesis) and trace the use of energy in supplying the food to us.

OBJECTIVE
C-1. To understand how the energy radiated by the sun is utilized on earth to maintain ecological processes.

PURPOSE
To show that the origin of all foods can be traced back to plant photosynthesis and that sunlight is the primary source of energy used by living things.

Time	Where
1 hour plus student homework	Classroom Home
Topics	**Materials**
Food chains, energy	Crayons or felt markers, large piece of butcher paper for each student, commercial- or teacher-made food calorie charts

LEAD-UP/PREPARATION
Teacher leads a class discussion on food energy.
Q: What is a calorie? (Unit of energy)
Q: Each food contains a certain number of calories. Suppose you ate only low-calorie foods. What would be the result? (A decrease in the energy available to your system would occur over time.)
Q: Does your body get energy to maintain your activity level and biological functions from any source other than food calories? (No)
Q: Where do foods get their energy content? (Chemical energy put into a usable form by photosynthesis.)

ACTIVITY

Step 1
Teacher distributes calorie charts.
Q: Which foods are the highest in energy? Are these the foods we generally think of as being fattening?
Q: How do calories get into foods?

Step 2
Each student will select a favorite food and trace it back through all of its stages.

Step 3
Have the students represent their food choices and the steps for processing the food by drawing a large mural.
Q: What do foods such as ice cream and steak have in common?
Q: Which foods require the fewest steps from source to plate? Which foods require the most steps? Which foods require the greatest expenditure of energy to process? Which foods require the least expenditure of energy?
Q: What is the primary source of energy for food production?
Q: What is the primary source of food energy (of calories)?

FOLLOW-UP
1. Have the students prepare a menu composed of only low calorie foods. You may limit the number of calories allowed to 500 per meal.
2. Have the students prepare a meal composed of only foods which require a minimum amount of processing and a minimum amount of energy to produce.
3. Have the students select a food they may be unfamiliar with—for example, poke salad or sushi—and compile as much information on it as possible. What is the ultimate source of this food?

Adapted from *Project Learning Tree*

DINOSAUR HUNT

DESCRIPTION
The teacher leads the class in an extended role-play, modeling the process of fossil fuel generation.

OBJECTIVE
C-2. To understand that energy can be stored by plants and converted through natural processes into large-scale energy sources, such as petroleum, natural gas, and coal.

PURPOSE
To trace the production of fossil fuels from their ultimate source to their discovery and to examine their exploitation by energy industries.

Time	Where
1 hour	Classroom or grassy, outdoor area
Topics	**Materials**
Fossil fuels, geology, energy resources	Role-play props (optional)

LEAD-UP/PREPARATION
The purpose of the role-play is to trace the generation of petroleum from its source to use by humans. (Please, there should be no dinosaurs in this role-play, because fossil fuels are *not* made from dead and decayed giant lizards.) Have a small group of students act as playwright researchers for the role-play or use the role-play narration outlined below.

ACTIVITY

Step 1
The teacher leads the class through the following role-play. Props, scenery, and costumes may be used. The use of mood music (student on a guitar, recorded music such as Beethoven's Symphony No. 6—Pastorale, or Stravinsky's *Rite of Spring*) is encouraged.

Role-play narration—the characters are the underlined characteristics. "One hundred million years ago in the mid-Cretaceous period, the *sun* shone down on widespread *warm tropical seas*, and on *lagoons* and *estuaries, fern forests,* and *swamp lands.*" (Students are assigned each of the underlined words as roles to play.) "*Microorganisms,* each bearing a *small drop of oily material,* swam in great abundance in the sea." (Students act out instructions.) "The organisms die and fall to the bottom of the warm seas and lagoons and estuaries along with *muck* derived from the land and microscopic skeletons of *other sea creatures* now long extinct. They are trapped in the mud and eventually buried thousands of feet (meters) below the sea bottom. The small drop of oily material is squeezed by *pressure* and heated by *friction* and *heat from the earth.* Some oil gets too hot and disappears. Some finds its way to the surface and disappears. But that which is trapped is slowly changed to crude oil and to natural gas. Along comes the *geologist.* After years of study, s/he has come to the conclusion that there is a pretty good chance that oil can be found in this region. S/he puts down a *well* and finds oil. S/he sets up a *pump* and extracts the oil. Only time will tell if s/he will make a profit on his/her activities."

Teacher and/or students may then create a role-play on coal generation.

Step 2

Class discussion.

Q: The energy from petroleum is used to run many of our machines. What is the ultimate source of petroleum energy? (sunlight). Fossil fuels are often referred to as energy "banks" or storehouses of sun's energy. What is meant by this?

Q: What efforts are being made to use sunlight as a direct source of energy to run our machines? Are windmills run by sunlight? (Yes, because wind is a result of differential heating of the atmosphere by the sun.)

FOLLOW-UP

Discussion. In the role-play, the sun's energy is found in different forms. Organisms convert it from light and heat to chemical energy stored in fats, oils, and carbohydrates. These are, in turn, changed to hydrocarbons (oil and gas) and organic carbon (coal). Human-made machines burn these to release heat to run their machines. This is a very complicated process from beginning to end. It results in much waste of energy and in many kinds of pollution.

Q: What can be done to simplify the use of the sun's energy? Solar, wind, and biomass energy?

Q: Are these solutions less polluting? Are they as economical and practical as today's processes?

THE STUFF OF STARS

DESCRIPTION

Students examine the role the sun has played in culture through the ages by describing and writing poetry, by making ethnographic studies of ancient and modern cultures, and by examining the importance of the sun in our culture.

OBJECTIVE

C-3. To understand that energy can neither be created nor destroyed. It is in a constant state of flux.

PURPOSE

To show that the sun has played a major role in the development of human culture. It is a source of energy and light and inspiration for humankind.

Time	**Where**
2-3 hours plus homework	Classroom
Topics	**Materials**
Solar energy, aesthetics, cultural history	Recordings of John Denver's song, "Sunshine on My Shoulder" (optional), library books, butcher paper, felt markers, crayons, or paints

LEAD-UP/PREPARATION

Play a recording of John Denver's "Sunshine on My Shoulder" for the class. Ask your students to express in some way, a drawing, poetry, dance, prose form, the feelings which are evoked in them by listening to the song. Share the poem "To Light Thou Shall Return," by Doris A. Simonis, with your class.

continued

To Light Thou Shall Return

Open the window:
let the out-light in.
Open the atom:
Let the in-light out.
From every direction
Energy spawns delight
Life is the interruption of light.
(copyright 1979 by Doris A. Simonis)

Q: The Biblical quotation says we shall return to dust. What does the title of the poem mean? Is dust really light? Einstein said that matter and light are two forms of the same thing. Is this what the title means?
Q: What does the poet mean by out-light? By in-light?
Q: Do you see the pun in the sixth line? (delight/the light)
Q: What does the last line mean? As time goes by, the universe is "running down." There is less and less energy available to use in cosmic processes, and the universe becomes more and more disorganized or random. The degree of the randomness of the universe is called "entropy." It is often said that life, which is a highly ordered state of matter and energy, is a "ripple on the stream of entropy." Is this what the poet has so elegantly described?

ACTIVITY

Step 1

Have each student select one of the topics below for individual research. Suggested topics:

- The People of Stonehenge
- The Egyptian Sun God, Amon Ra, and the Pharaoh Ikhnaton
- The Greco Roman God Apollo
- The Myth of Phaeton
- Sun Boy Creation Myth of the Kiowa
- Aztec Sun Worship
- Aztec Royal Hunt of the Sun
- Inca Sun Worship
- Anasazi Sun Calendar
- The Sundance Rituals of the Plains Indians
- Others

Step 2

Have the reports shared with the rest of the class.

Step 3

Create a sun mural as a class project which brings together all of the ancient and primitive cultural aspects of the sun, as reported above.

FOLLOW-UP

Have your students search the popular media (television, radio, newspapers, etc.) for sun ads (Sunkist, Sunmaid, etc.)
Q: What does the sun, as used by advertisers, signify?

WHY DO TREES GROW THERE?

DESCRIPTION
Through experiments and observation games, students make scientific and value judgments on the probability and desirability of trees in the environment.

OBJECTIVE
D-1. To understand the factors which determine the variety and abundance of life that can be supported within a geographic area.

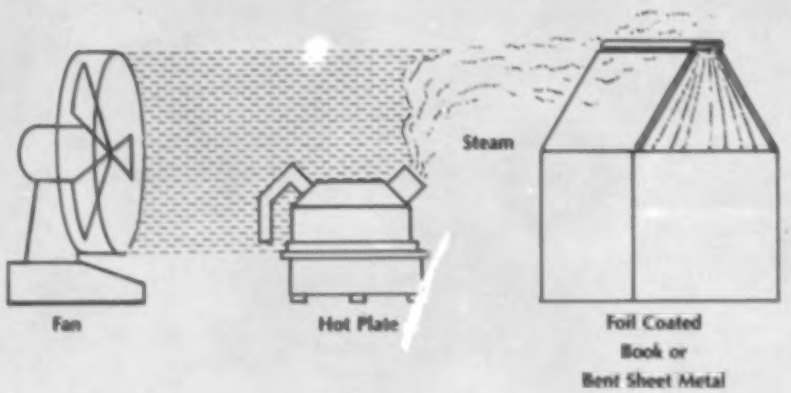
PURPOSE
To show that space, climate, nutrients, water, and human factors limit the variety and abundance of life which can be supported in a given geographic area.

Time	Where
1-2 hours	Classroom, yard, walking tour of neighborhood
Topics	**Materials**
Forests, climate, urban ecology, scientific methods	Piece of sheet metal folded, as in illustration, or aluminum foil wrapped around a large book; hot plate, tea kettle, fan, thermometers

LEAD-UP/PREPARATION
Construct a metal tent by folding a piece of sheet metal down the middle, or wrap a piece of aluminum foil around a large book. Chill the tent for three hours. Boil water in a tea kettle.

ACTIVITY

Step 1
Arrange a fan so that it blows steam from the kettle onto the sheet metal "mountain."
Ask students to observe the condensation which occurs on the "upwind" side of the mountain.
Q: Which side is the most favorable for plant growth?
Q: Which side is the least favorable for plant growth?
Q: Do you live in a region affected by mountain-caused rain and snow?



Step 2
Fasten thermometers to each side of the "mountain." Take the mountain outside and check the thermometer readings as you turn the mountain in different directions with respect to the direction of the sun, and the direction of the wind.
Q: How does orientation with respect to the sun and wind affect plant growth?

continued

Step 3

Take a walk around your neighborhood. For each tree that you see, ask:

Q: Is this tree planted by humans, or is it naturally occurring in this spot?

Q: How well is this tree doing? Is it growing and healthy? Could any improvements be made to enhance the tree's health?

Q: Are there any signs of human intervention (cut limbs, litter, tree doctoring, etc.)? Is this human interference good or bad?

Q: Where does this tree get its water? Nutrients?

FOLLOW-UP

Have your students identify the trees in the neighborhood.

Have your students design their ideal home. What use did they make of trees and shrubs? (Aesthetic, energy saving, structural, noise, recreational, etc.)

Contact your local Department of Public Works, Parks and Recreation Department, and/or citizens group (Los Angeles Tree People, San Francisco Friends of the Urban Forest, Oakland Tree Task Force, etc.) concerned with planting and maintaining street trees, local ordinances affecting street trees, and resources available to the citizen who wishes to plant trees in his/her neighborhood. Perhaps they can arrange for your class to tour their facilities or will provide films or speakers.

Adapted from *Project Learning Tree*

ENDANGERED SPECIES

DESCRIPTION

Students research local endangered species, analyze reasons for the species' distress, examine trends in population numbers, and prepare action statements.

OBJECTIVE

D-2. To understand how the biological community of plants, animals, and microorganisms adapts to the environment through changes in genetic composition and population size.

PURPOSE

Students will be able to identify the factors which contribute to endangering a species and devise a plan for action which may help the species survive.

Time	Where
1 hour in class, homework	Classroom
Topics	**Materials**
Wildlife, ecological balance, preservation	Lists of endangered species

LEAD-UP/PREPARATION

Obtain a list of locally rare or endangered animal species from the U.S. Fish and Wildlife Service or the State Wildlife Service. A list of endangered plant species may be obtained from the U.S. Department of Agriculture.

ACTIVITY

Step 1

Ask each student to select an animal from the list of endangered species and gather information about its problems. Student reports might include the following information about each species:

- Past and present range and population estimates
- Length of time it has been on the endangered list
- Reasons it is endangered
- Actions currently being taken to help ensure its survival
- A list of agencies, action groups, or others who are working towards its survival
- A list of agencies, action groups, or others who are working towards its demise, either purposefully or inadvertently
- Why it is important that this species survive

Step 2

Create a chart listing each species, the length of time it has been endangered, etc. Add any other categories of information and analyses you and your students may find interesting. Look for trends on your chart.

Q: What do these charts indicate about the trend in decreasing habitat?

Q: What other trends do you notice?

FOLLOW-UP

1. Find practical actions that private citizens might take to assist in the preservation of a species.
2. Prepare awareness materials on endangered species to share with your school and community.
3. Prepare a list of endangered marine mammals. What groups are concerned with marine mammals? What are the special problems of marine mammals in the fight for survival?

Adapted from Project Learning Tree

THUMBS UP, THUMBS DOWN

DESCRIPTION

Students rate environmentally sensitive and controversial practices, (e.g., using aluminum pop cans, strip mining, deer hunting, etc.) on a values continuum. Students discuss the "good" and "bad" consequences of these issues and make value judgments based on a fuller discussion of each. Routes to personal action on these issues are discussed.

OBJECTIVE

D-3. To understand how humans manipulate the environment and cause changes in the balance of conditions.

PURPOSE

To list and obtain value decisions from students on controversial "issue-nouns" so that students may identify the environmental impact of common Western practices.

Time	**Where**
Approximately 2 hours	Classroom
Topics	**Materials**
Environmental values, environmental ethics, energy	Continuum chart for each student

LEAD-UP/PREPARATION

Make a copy of the Values Continuum Chart on the next page for each student.

continued

VALUES

What do you think?

Rate each of the issues by making a check mark under the heading that best describes your opinion.

	Very Desirable	Acceptable	Undesirable	Totally Unacceptable
Using chemical fertilizers				
Using plastic containers				
Using aerosol sprays for household use				
Building dams				
Drilling offshore oil wells in California				
Drilling offshore oil wells in New Jersey				
Hunting deer				
Dumping wastes in the ocean				
Driving a car				
Using pesticides				
Cutting down redwoods				
Building a new house in the country				
Generating energy in nuclear plants				
Eating meat				
Building more highways				
Controlling disease in humans				
Destroying crops to raise prices				
(Teacher should add some more up to date and local interest topics.)				

ACTIVITY

Step 1

Have each student fill out the Values Continuum chart.

Step 2

Divide your class into small groups of three to four students. Have one member of each group justify his/her answers to the rest of the group. Then allow the rest of the group to voice agreement or disagreement and give the reasons why. *Each group must come to a consensus on each issue.* You may need to give 15 minutes or more on each issue. (The teacher may, however, choose to place a time limit on the consideration of each issue.)

Step 3

Have one group present its consensus for discussion by the entire class. See if it is possible to come to a consensus of the whole class. Define consensus. Is a consensus merely a simple majority or plurality? Ask the class how it should deal with strong minority opinions; with weak minority opinions. Ask, "Is there some research we can do to clarify a given issue so that a consensus may be reached on every issue?"

Q: What difficulties exist when a society has to make decisions on these sorts of issues?

Q: Why are so many of these issues undecided in our society?

Q: In what sort of society would these issues be resolved immediately?

FOLLOW-UP

Pick one issue of immediate concern to your class. What sorts of actions can the class take to help move these issues to a desired resolution? Do it.

BABY, IT'S COLD OUTSIDE

DESCRIPTION
Students assess the possible causes of global glaciation. One theory, the Donn-Ewing theory, is discussed and students write a glacial disaster scenario. The effects of CO_2 and particulate air pollution on global temperatures are discussed.

OBJECTIVE
D-4. To understand the natural forces that continually shape the environment.

PURPOSE
To show that natural forces shape the earth and continue to change the natural environment.

Time	Where
1 hour class time, plus student time outside	Classroom
Topics	**Materials**
Geology, natural disasters, climate, air pollution	Physical geology textbooks and nontechnical earth science books, with information on glaciers

LEAD-UP/PREPARATION
Consult any or several college-level physical geology textbooks or other sources for descriptions of continental glaciation, the times of glaciation in the past, and the effects of glaciation on landforms. Discuss the glaciations of the Pleistocene with special reference to California. Have students learn some of the extensive vocabulary associated with the field of glaciology. Many geologists facetiously refer to the Pleistocene epoch as the "Pleisto-scenic," because much of the beautiful mountain and lake scenery of the world was sculpted by the glaciers of the Pleistocene epoch. Create a "California Pleisto-scenic" bulletin board using pictures from magazines or student-made drawings.

ACTIVITY

Step 1

Have your students write the outline of a script for a disaster movie entitled "Baby, It's Cold Outside" about what would happen to an average family living in California if the glaciers were to re-form and move south again as they have four times over the last million years. Make sure they include in their script:

- The change in the weather
- The change in the climate
- The change in food growing regions
- A cause for the new glaciation ("caused by atomic testing in the Indian Ocean")
- A politician
- An environmentalist
- A school teacher
- A song (destined for an Academy Award)
- Attempts by the Army Corps of Engineers to stop the ice
- People fleeing

Step 2

Share selected scripts with the entire class.

Step 3

Discuss:

Q: What causes did you propose for the glaciation?
Q: Which causes are most likely?
Q: Which causes have a human origin?
Q: When wheat will no longer grow in Canada or in the United States, how will this change our relationship with Latin America? Are there other resources which Latin America has which have changed our relations with our southern neighbors? (Mexican oil)
Q: What would be the effect of glaciation on land at sea level, on marine organisms?

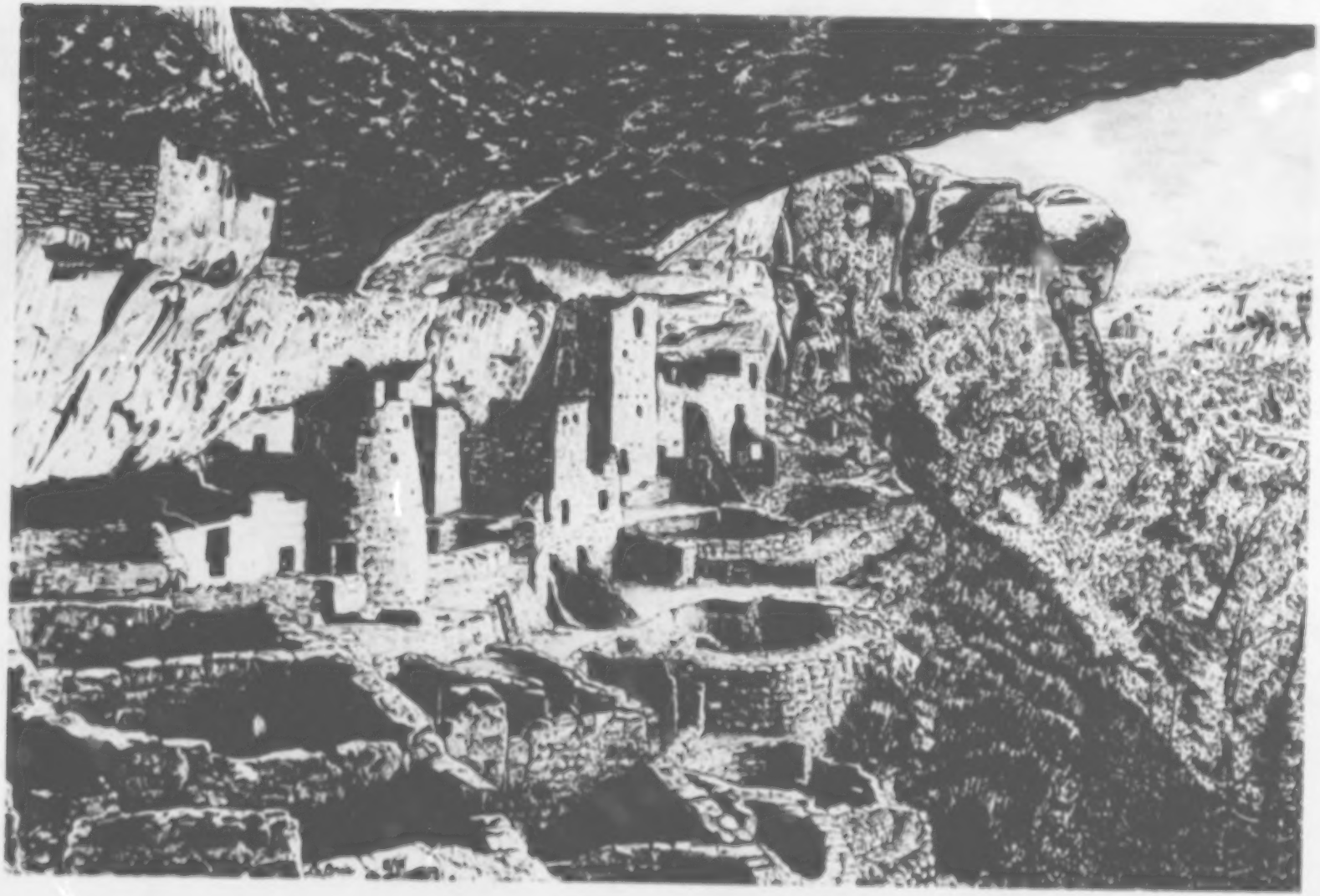
continued

FOLLOW-UP

Discuss the "greenhouse effect." What natural factors might turn our atmosphere into a greenhouse wall (volcanic eruptions, meteoric impacts)? What human-made factors might turn our atmosphere into a greenhouse wall (particulate and CO_2 air pollution from cars, etc.)? Most theories which try to explain the recurrence of glaciation do so by proposing a mechanism which would cool the earth down sufficiently so that glaciers would form and not be melted away. The Donn-Ewing theory proposes that the earth's atmosphere needs to warm up so that precipitation would increase in northern latitudes; the resulting snow layer would be too thick to melt entirely during the summer, but would grow through successive winters. If this is feasible, can cars cause glaciers?

NOTES

Built Environment Activities



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BUILT ENVIRONMENT

Issues

Built Environments or human communities have evolved out of the natural environment over the past two to three million years. As innately social animals, we humans have consistently engaged in group efforts to satisfy our basic needs. Our communities stand as dynamic evidence of our efforts thus far. Human communities share many characteristics with other living systems, such as the need for nutrients, energy, food, materials for shelter, and waste disposal. Our techniques for satisfying needs and desires, however, have had much wider impact than those of any other organism. We have reached out over greater areas to gather the resources to support our lifestyles and we have deposited our wastes on the land and in the air and water.

As Built Environments continue to evolve, the quality of life for their inhabitants has improved in some respects and declined in others. We can cite astounding technological advances in areas such as health care, communications, transportation, and the production of goods. Yet, these advances have brought concomitant dilemmas. For example, advances in health care have resulted in the obliteration of many diseases and the prolongation of human lives. However, this has caused increased population growth which, in turn, has resulted in increased competition for natural resources. Advances in communications technology has made it possible to retrieve information from any part of the globe within seconds. Yet, it also contributes to a loss of control, as methods for processing information become more centralized and our individual "data banks" become overloaded. Industrialized countries have advanced exploration and transportation technologies to the point where we have access to natural resources throughout the world. Yet, the distribution of these resources is grossly unequal with 33 percent of the world's population consuming 80 percent of the available resources. Finally, advances in the production of goods have resulted in wider choices, lower prices, and an improved quality of goods for the consumer. Unfortunately, the quality of the work place has suffered as workers often find their highly automated jobs dull and meaningless.

These are merely a few of the technological advances and concomitant problems that have accompanied the evolution of the Built Environment. As we strive to build healthier communities, we must consider the central area of human environments: the cities. They serve as the hub of social, political, and economic activity. As cities grow in size and complexity, they generally become less desirable places to live. Currently, we see evidence of an increased dissatisfaction with city life as more and more people move to the urban fringe. Fortunately, we can also see evidence of efforts to revitalize the city by improving housing and public transportation and reestablishing a sense of community. As we strive to improve the Built Environment, perhaps we should begin by improving the quality of life within our cities.

Three concepts have been defined for enhancing student understanding of the Built Environment. The first considers the dependency of the Built Environment on the Natural Environment. The second considers the evolution of the Built Environment and the influence of societal values on that process. The third stresses a perspective that views the Built and Natural Environments as intertwined through an intimate cause/effect relationship.

BUILT ENVIRONMENT

MAJOR CONCEPTS	OBJECTIVES
A. Built environments depend on resources from the natural environment for survival.	1. To understand that built environments require continuous supplies of energy and resources from the natural environment. 2. To understand how humans manipulate and cultivate the natural environment to ensure consistent and continuous supplies of resources for built environments. 3. To understand how technology expands the geographic area from which built environments draw on resources from the natural environment.
B. The design and maintenance of built environments have both reflected and influenced the values, ethics, and lifestyles of the inhabitants.	1. To understand how geographic location, available space, people's needs for services, human contacts, and aesthetic stimulation interact in determining the design of a built environment. 2. To understand how technological development and industrial expansion have contributed to the development of the modern day megalopolis in all parts of the world. 3. To understand how individual and societal values and ethics influence the design of different types of built environments.
C. Built and natural environments function in similar ways and share many basic needs for survival and growth.	1. To understand that continuing supplies of energy are essential for the maintenance of life in both natural and built environments. 2. To understand how both built and natural environments are dependent on the continuous renewal of resources. 3. To understand that built and natural environments are continuously interactive, and changes in one area of the environment can cause changes in many other areas.

BUILT ENVIRONMENT OBJECTIVES & ACTIVITIES

		K-3	4-6	7-9	10-12
CONCEPT A	1. To understand that built environments require continuous supplies of energy and resources from the natural environment.	Students examine natural structures and build some of their own.	Students analyze a collection of items to discover what resources were used to manufacture them.	Students design and keep an energy log for one day.	In a game, students identify the materials and energy consuming processes which went into the building of the school plant.
	2. To understand how humans manipulate and cultivate the natural environment to ensure consistent and continuous supplies of resources for built environments.	Students express appreciation for natural resources contributing to their lives.	Students look "beyond" the supermarket shelves at the relationship between the land and food.	Students interview older persons to learn of the sources of resources in the past.	Students design a park for their community.
	3. To understand how technology expands the geographic area from which built environments draw on resources from the natural environment.	Small groups create a mural or mobile showing the origin of the component parts of common items.	Students find out **everything** they can about chalk: its origin, uses, manufacture, history, etymology.	Students read two river poems and write some of their own. The river is fragile, a metaphor for our own flow.	Students exchange "environmental materials" with another class in a different region.
CONCEPT B	1. To understand how geographic location, available space, and people's needs for services, human contacts, and aesthetic stimulation interact in determining the design of a built environment.	Students experience different "population densities" in the classroom and discuss the effects of each situation.	Students design a small town in which they would like to live, and then must resolve the problem of increasing population.	Students shop for "wants" in stores of their own design.	Through word manipulation and other arts media, students share perceptions of societies' successes and/or failures in meeting personal needs.
	2. To understand how technological development and industrial expansion have contributed to the development of the modern day megalopolises in all parts of the world.	Students draw a picture of a dwelling used in a primitive society and a dwelling from the neighborhood. They list the differences in the dwellings.	Students inventory all of the materials and energy sources needed to play baseball.	Students draw lines between environmental concepts to show interconnections.	Class takes a field trip to a local secondhand store and compares goods of different vintages.
	3. To understand how individual and societal values and ethics influence the design of different types of built environments.	Students discuss and try out ways of physically arranging the classroom.	Students inventory and evaluate the energy-using aids and appliances in their homes.	Eating pretzels as fuel, students investigate transportation alternatives through a game.	Students run an extended role-play based on a Federal Court hearing on land use.
CONCEPT C	1. To understand that continuing supplies of energy are essential for the maintenance of life in both natural and built environments.	Students do physical exercises, observe and build simple machines, and discuss energy needs for various tasks and occupations.	Students perform an experiment with yeast to show that biological functions require energy and that the system loses heat.	Students assess all of the energy that goes into a garden. Several types of gardens are detailed.	Students analyze an oil company's "energy time line" which makes predictions for the future.
	2. To understand how both built and natural environments are dependent on the continuous renewal of resources.	Students examine changes in water, air, and the sun's movement on the school grounds.	Students draw pictures of their dwellings if environmental factors (space, climate, etc.) were changed.	Students assess the artist's values through analysis of landscape painting.	Students outline the environmental implications of the freedom to live wherever they desire.
	3. To understand that built and natural environments are continuously interactive and changes in one area of the environment can cause changes in many other areas.	Students list all of the things a plant needs for survival and then extend these factors to their own cases.	Students examine the differences which exist on different sides of a building with respect to the plant life and other environmental factors.	Students examine human uses of snow in various regions.	Students generate a list of possible environmental happenings and then list the consequences of those.

UNBUILD YOUR SCHOOL

DESCRIPTION
In a game format, students identify the materials and energy-consuming processes which went into the building of the school plant.

OBJECTIVE
A-1. To understand that built environments require continuous supplies of energy and resources from the natural environment.

PURPOSE
To show that built environments require energy and materials from the natural environment.

Time	Where
1 hour	Classroom
Topics	**Materials**
Energy resources, technology, human ecology	None

LEAD-UP/PREPARATION
Arrange for the custodian or maintenance engineer of your school to visit your classroom for a question/answer period. Perhaps s/he can lead a tour of those areas of the school that are often off-limits to students (boiler room, roof, maintenance shed, etc.).

ACTIVITY

Step 1
Divide your class into five or six teams. Give the teams five minutes to list as many materials as possible which went into the construction of the school building and grounds.

Step 2
Then give the teams five minutes to list as many *energy users* as possible which went into the construction of the school and its grounds. (Energy users are machines and humanpower.) The team with the most items listed in Steps #1 and #2 wins the competition.

Step 3
The winning team leads the class in an *imaginary* game (please!) of tearing the school apart in reverse order to its construction. "First we'll rip up the bushes; then we'll tear up the playground; then we'll remove the windows; then unhinge the doors, heh, heh, etc." This exercise will illustrate, in reverse order, the steps taken to build the school.

FOLLOW-UP
1. Choose a limited number of materials used to construct the school and trace these materials back to their sources. What are the natural sources of these materials?
2. Ask for research papers on the following topics:
   - The History of Portland Cement
   - Landscaping for Aesthetics, Low Cost, Low Maintenance, and Energy Conservation
   - The History of Local Construction Codes
   - Fireproofing the School
3. Have your students draw pictures of the school at various stages of its construction.

GO PARK IT

DESCRIPTION
Students design a park for their community. They examine the trade-offs necessary to the building of a park to serve the needs of most of the people. They also examine the resources available to their community for the building of a park.

OBJECTIVE
A-2. To understand how humans manipulate and cultivate the natural environment to ensure consistent and continuous supplies of resources for built environments.

PURPOSE
To demonstrate that people manipulate their environment for the maintenance of their lifestyles.

Time	Where
2 hours	Local neighborhood park (optional) Classroom
Topics	**Materials**
Land use planning, urban environment, recreation	Appropriate art supplies for small groups

LEAD-UP/PREPARATION
Make a survey of a neighborhood park. What facilities are available? What could be done that isn't being done? What in this park is especially good? What improvements need to be made in the short and long term? Invite a representative from your local park agency to visit your class.

ACTIVITY
Step 1
The students will design a park. Divide the class into small groups. Assign each group the following task: your group has been hired by the county (city) to design a park for surplus land located at _____ (a hypothetical location in your community). The park will cover 320 acres (about one half of a square mile or 128 hectares). You have a large but not an unlimited budget. (Teacher should feel free to vary any of the above parameters to suit the particular local situation.)

Step 2
When the designs are finished, ask the groups to share their designs.

Step 3
Ask the following questions:
Q: What percentage of our local population will use this park at least once every two weeks?
Q: What provisions have been made for: seniors, the handicapped, small children, young adults, families, pets, runners, bikers, automobiles, environmental demonstration projects, being alone, and sports?
Q: Does the design of your park promote its use by large numbers of people, or is it in some way restricted to use by small groups?
Q: What have you done to provide for the security of the users of the park? Is the park an attractive place to be at night?
Q: How will your park affect the citizens who live within walking distance of it?

Step 4
Have the groups redesign their parks, with consideration given to the above questions.

FOLLOW-UP
1. Have the students list the resources, natural and human-derived, which went into the building of their park.
2. Have the students compute a budget for the construction *and* maintenance of their park.
3. Have the students submit a plan for the improvement of a real neighborhood park (ideas, ways and means, budget) to the appropriate authority. Follow up the submission of their plans with requests for comments from the agency involved.
4. *Discuss:* "Park disuse and misuse is a function of the lack of community involvement. It is a case of you get what you deserve."

ENVIRONMENTAL EXCHANGE BOX

DESCRIPTION
Students exchange "environmental materials" with another class in a different region of the state and/or country. These materials represent local environmental concerns, natural resources, and products from each region.

OBJECTIVE
A-3. To understand how technology expands the geographic area from which built environments can draw on resources from the natural environment.

PURPOSE
To develop an awareness of environmental concerns in other parts of the state and country; and to show that each region generates a distinct set of natural resources and products on which our complex built environment depends.

Time	Where
Ongoing project	Classroom and student time in the community
Topics	**Materials**
Human ecology, economics, quality of life	Varied, reflecting environmental concerns, products, and resources of your region (see below); 2 cardboard boxes for mailing

LEAD-UP/PREPARATION
Teacher contacts a teacher in another region of California or in another state. (Try to find an area which is environmentally different from your local area.) Teachers in other regions may be located by writing to the state board of education. Another source of teachers who may be interested would be through an environmental education agency. Once contact has been made, ask your students to do background reading on the other region to get a feel for its topography, cultural life, weather and climate, history, etc. If possible, bring in a film or pictures of the region.

ACTIVITY

Step 1
Have the class select a steering committee of three students. They will have final say on what goes in the environmental exchange box which the teacher has prepared for shipment to the correspondent school.

Step 2
Brainstorm a list of items which demonstrate local environmental concerns, local natural resources, and local products. Such a list might include a collection of newspaper clippings on local environmental issues, samples of local agricultural products, pictures of ads for local manufacturers, etc. Have the students gather and prepare the items for mailing. Be sure that organic materials are carefully wrapped.

Step 3
Assign students to research and write reports on suggested materials. These reports can be mailed with the items.

Step 4
On a date mutually agreed upon by the two teachers, the environmental exchange boxes should be packed, sealed, and mailed. Be sure to enclose a picture of the class, with names attached.

FOLLOW-UP
Once the boxes have been exchanged, ask your students to describe the differences and similarities between the two regions. Try an International Environmental Exchange Box with a school in a different country.

Adapted from *Project Learning Tree*

MEANINGFUL OPPOSITES

DESCRIPTION
Through word manipulation and other arts media, students share perceptions of society's successes and failures in meeting personal needs.

OBJECTIVE
B-1. To understand how geographic location, available space, and people's needs for services, human contacts, and aesthetic stimulation interact in determining the design of a built environment.

PURPOSE
To demonstrate that a built environment must meet personal needs to be considered successful as a provider of a quality life; that the assessment of a built environment's success is a personal thing.

Time	Where
1 hour	Classroom
Topics	**Materials**
Environmental values, human ecology, aesthetics	None

LEAD-UP/PREPARATION
Teacher may share an anecdote about how the built environment does not meet a personal need; perhaps how the freeway rush doesn't allow one to get home quickly and results in a loss of valuable time with family; or how the telephone can infringe on privacy. Ask your students to share similar stories with the class. Then teacher shares a story about how our modern built environment makes life richer; for example, how one can go to the ballet without going to New York; or how air transportation makes it possible to visit the Midwest on short notice. Ask the students to share similar anecdotes with the class.

ACTIVITY

Step 1
Teacher writes the following statement on the board, "Sometimes as I go through my life, I feel . . ." and asks students to list words to complete the statement. Teacher lists the responses in one column and then lists the opposite, with the students' help, of each word or phrase. The columns might look like this:

confused — clarified
strong — weak
endangered — secure
angry — calm, happy
in charge — at the mercy of

Collect about ten sets of opposite pairs.

Step 2
Create some criteria by which each student may select one word pair for further work. Suggest, perhaps, that the student pick the word pair closest to his/her experience of that particular day, or that the student pick a word pair which s/he feels is closest to a recent experience of a loved one, or a pair which is the strongest, or one which is the most strange or unusual.

Step 3
The student's task is to create some art form, poem, drawing, prose form, verbal or graphic, depicting the success or failure our society has had in meeting the student's personal needs, as reflected through the word pair s/he has chosen.

Step 4
Ask for volunteers to share their work with the class.
Discuss: Some philosophers and artists have characterized our modern environment as being inadequate to meet many of our human needs.
Q: Material needs are often satisfied, but what about emotional and spiritual needs? What are some of those needs? How well are they satisfied in your life?

continued

Some people believe that *because* our material needs are satisfied, it becomes harder than ever to satisfy our emotional and spiritual needs.
Q: What do you think?
Our built environment changes at an ever-accelerating pace. Everything is "new," "better," "fast," with media and ideas piled ever more deeply and quickly upon us. This is a part of the cause of the modern phenomena called Future Shock.
Q: Can you give examples of rapid changes you have observed and experienced in your life? How many of these are good for you? How many are bad for you?
This is the only society we have. Soon, perhaps because of economic pressure and rising aspirations, all of the world will share in one society. There may be no opportunity to leave the modern world for wilderness or for an experience in another culture. Many would agree that this would have some negative consequences.
Q: What are some potentially *positive* consequences? Is there anything that can be done to alter this trend? What are the trade-offs which are necessary if we attempt to ensure that diversity is maintained?

FOLLOW-UP

1. Assign readings from *Future Shock* by Alvin Toffler. It may be worthwhile to point out that even though Toffler's characterizations of our society and its accelerating change rate are essentially correct, many of his predictions, made in 1967, have proven to be incorrect.
2. Repeat the activity several weeks to several months later. Ask, "How have your perceptions of how well our society is meeting your needs changed since last time we did this?"
3. Read the lyrics of the John Lennon song "Imagine" to the class. Go through each of the Beatles' postulated "improvements" to our society and ask, "What else would have to change in our lives if each of these things happened? Are these proposals (each of them) real long-term solutions to our world's problems?"

GRANDMA'S VTR

DESCRIPTION

Class takes a field trip to a local secondhand store and compares goods of different vintages; for example, chairs from different time periods. Students interview older persons to compare household goods of past and present.

OBJECTIVE

B-2. To understand how technological development and industrial expansion have contributed to the development of the modern day megalopolises in all parts of the world.

PURPOSE

Students will see that material goods change through time as styles and availability of materials change. Technological advance promotes complexity even in everyday things.

Time	Where
1-2 hours	Field trip to local store, classroom
Topics	**Materials**
Recycling, economics, history, technology	None

LEAD-UP/PREPARATION

Ask students to make a list of household goods that their family owns which it did not own five years ago.
Q: Which of the items on your list was not available to the public or was prohibitively expensive five years ago? (Video-tape recorders, video discs, personal computers, other high-technology items, new fad clothes, foods, etc.)

ACTIVITY

Step 1

With the approval and cooperation of your local merchant, take a brief field trip to a secondhand store. Find two items which perform the same function, but were manufactured several years apart; for example, a "Danish modern" chair from the fifties and a tubular steel and wicker model from the early seventies. Ask your merchant for his/her expertise on the vintages of the merchandise selected.

Compare the two items for:

- materials used in construction
- durability over the years
- quality of work
- value in dollars today
- collector's value, if any

Step 2

After returning to the classroom, ask the students to make value judgments about the items:

Q: Which would you rather own? Why?

Q: Why is each of these items made of different materials?

Q: What are the chairs in your home made of?

Q: How do the chairs in your home differ from the ones we saw in the store? Why do manufacturers improve their products over time? Are all the improvements really improvements? Give examples of some which are not.

Q: Comparing chairs of different vintage, has the quality of construction increased or decreased over time? What about the quality of materials?

Q: Which chair will probably last the longest?

Discuss:

In today's society we have more choices as to what we can use to manufacture an item. For example, we have alloys, plastics, exotic foreign materials, such as tropical woods, etc., available to us which were not available even a few years ago. Would you say that this has resulted in higher quality or lower quality household goods?

FOLLOW-UP

1. Have your students each interview an older person about the quality of household goods over the years. A good way to start is to have your students ask, "How did you toast your bread when you were a child?" Through a class discussion, generate a series of similar questions. Ask students to predict and draw what a selected item will look like in 50 years.
2. Values—Do "quality" goods promote the quality of life?

Adapted from *Project Learning Tree*

WHO'S RIGHT? WHOSE RIGHTS?

DESCRIPTION

Students participate in an extended role-play based on a federal court hearing on land use with respect to the search for fossil fuels. Students are asked to model and represent the factions and interests with a stake in the outcome of a federal court decision to open up western lands to strip mining.

OBJECTIVE

B-3. To understand how individual and societal values and ethics influence the design of different types of built environments.

PURPOSE

The student will be able to describe the intricacies of proprietary rights and personal, as well as institutional, power concerned with the development of resources used by modern society.

Time	Where
1-week unit with possibilities for extension	Classroom
Topics	**Materials**
Land use, fossil fuels, economics	Optional props to simulate a federal court hearing room

LEAD-UP/PREPARATION

Have the students collect articles on the actions of the courts, congress, or state legislature on an environmental issue. Create an issue bulletin board. Have the students note the names of the jurists and congresspersons involved in each of the issues.

Q: Do certain names appear over and over?

Q: What is the role of the courts and the role of the legislature in gathering appropriate information?

Q: What resources does a judge or a congressperson have to help him/her make decisions?

ACTIVITY

Step 1

Inform your students that they will be participating in a role-play based upon the following premise. (Have them make up a list of those persons who should be represented in the role-play after you read:)

The Martin and Robinson Coal Company has filed a request and an environmental impact report with the Federal Bureau of Land Management and the Federal Bureau of Indian Affairs to extend its strip mining operation into 300 square miles of the Sioux Nations Reservation of northern Montana. The company has stated publicly that unless permission is granted to extend its strip mine, it will have to shut down all of its operations in the area. The request of the company has the support of local business and labor groups and of the majority of the tribal council.

Local and national conservation groups maintain that the expanded operation will not only destroy 300 square miles of rapidly diminishing high plains habitat, but will also endanger the Rensel River which flows through the reservation from north to south. Farmers and small communities downstream also oppose the expansion fearing that their water supply will be interrupted and contaminated by the operations and the wastes from the diggings.

The Martin and Robinson Coal Corporation has had an excellent record in the past of cleaning up and replanting stripped areas and, in general, of showing concern for the environment. But the opposition says that the company's new management refuses to speak with it.

The battle lines have been formed by a suit filed by a local environmental group, the Friends of the Rensel, to secure an injunction against the federal agencies requiring that they not act on the coal company's requests.

The scene is the Federal Courthouse in Helena, Montana. The judge, Joanna Gilbert, must decide, from the testimony given today, whether or not to grant the injunction.

Step 2
Have your class generate a list of the parties who should give testimony.

Step 3
Ask for volunteers for the various roles, including that of the judge and the two attorneys for the opposing sides. Try to get everyone involved. Be as realistic as possible; the use of props and costumes and even rudimentary scenery will enhance the role-play.

Step 4
Do the role-play as a one day project or give your students more time to prepare their testimony and supporting evidence. Remember, a lot of "facts" will have to be made up by the students. What do you do if there is conflicting evidence?

You will find your students getting very involved in this as the advocacy situation intensifies. You may want to instruct your judge that she has the power of finding persons in her court in contempt! Encourage character development. Don't settle for stereotypes!

FOLLOW-UP

1. Perhaps, after the arguments are refined, your class can present its role-play to the school assembly or to other classes involved in energy or environmental learning.
2. Have each student design a similar role-play based on another local environmental or energy issue. Use it as a base for further lessons.
3. Before the role-play begins, have each student predict the chief argument for each witness. After the role-play, discuss whether or not their predictions were correct.

TIME AFTER TIME LINE

DESCRIPTION

Students analyze an oil company's energy time line, which makes predictions for the future.

OBJECTIVE

C-1. To understand that continuing supplies of energy are essential for maintenance of life in both natural and built environments.

PURPOSE

To describe the growth of our dependence and reliance on energy sources. To discuss alternatives possible within the framework of our modern society.

Time	Where
2 hours	Classroom
Topics	**Materials**
Cultural history, technology, energy	Time line (see Activity Step 1)

LEAD-UP/PREPARATION

Prepare a copy of the time line below for each student.

ACTIVITY

Step 1
Distribute the time line to your students.

ENERGY TIME LINE

1750	Most people use wood as domestic energy source. Transportation is by horse and foot.
1769	James Watt, building on the work of Newcomen and others, perfects the steam engine.
1791	Anthracite coal found in Pennsylvania; considered worthless.
1800	Battery perfected by Alessandro Volta.

continued

1804 Steam engine put to work as a railroad locomotive.
1821 First natural gas well in United States at Fredonia, New York.
1831 Electric generator perfected by Michael Faraday. Electricity produced by induction from a magnet.
1836 Steam shovel invented by William Otis.
1856 Professor William Silliman tries to find uses for crude oil; considered a worthless liquid.
1859 First oil well drilled by Edwin Drake.
1860 First practical internal combustion engine is invented by Lenoir.
1865 First natural gas corporation formed.
1869 United States linked by transcontinental railroad.
1879 Edison perfects electric light.
1884 Steam driven turbine invented by Charles Parsons.
1885 Coal replaces wood as main source of energy in United States.
1886 First practical automobile invented by Karl Benz.
1892 Rudolf Diesel invents oil-run engine.
1895 Hydroelectric power is produced by Niagara Falls.
1901 Huge quantities of oil are discovered in Texas at Spindletop Field.
1903 First airplane flown by Wright Brothers.
1938 Nylon invented, a new fiber made from petroleum.
1940 Oil replaces coal as number one source of energy in United States.
1942 First nuclear chain reaction demonstrated by Enrico Fermi.
1945 First nuclear bombs used in warfare; World War II ends.
1955 First solar cell perfected.
1957 First nuclear power plant opens.
1960 Power failure blacks out northeastern United States.
1969 Men walk on the moon.
1970 First United States Clean Air Act passed.
1973 Arab oil embargo—oil used as a political tool.
1977 Alaska Pipeline opens.
1979 Serious nuclear accident at Three Mile Island, Pennsylvania.

Step 2
Have your students divide into small groups and brainstorm possible upcoming events and add to the time line up to the year 2277.

Step 3
Distribute the addenda below:

1980 Heber geothermal plant using hot water goes into operation.
1985 Nuclear power supplies up to eight percent of United States energy needs. Some breeder reactors in operation.
1990 Gas and liquids from oil shales become important energy source.
2000 Solar energy becomes commonly available as a large scale source of energy. Solar may supply up to three percent of our needs for space heating and water heating.
2023 Potential reserves of oil and natural gas may be used up.
2277 Potential reserves of coal may be used up.

—Time line from Energy Learning Center, Communications and Education Group, Chevron, U.S.A.

Have students compare their time lines with the addenda. The entire time line, including the addenda, is from a publication put out by a major United States oil company, Chevron U.S.A. What effect, if any, does this have on the items chosen for the time line?

Step 4
Q: How would you change the time line if you could?
Q: What sorts of events are not included on the time line which should be?
Q: Do you agree with the numbers on the addenda; i.e., eight percent for nuclear and three percent for solar?
Q: If your assessment of our energy future is different from that outlined in the addenda, is yours more optimistic or pessimistic? Is yours more or less realistic and practical? What can you do to change our energy future to something you consider to be better?

Step 5
Have students write a time line they think an environmental citizens' group would publish in rebuttal to the one above. Is either more or less accurate than the other?

FOLLOW-UP
Have students select an event of interest from the time line and do more research into it.

PIKE'S PEAK OR BUST

DESCRIPTION
Students outline the environmental implications of the freedom to live wherever they desire.

OBJECTIVE
C-2. To understand how both built and natural environments are dependent on the continuous renewal of resources.

PURPOSE
Students outline the environmental implications of the freedom to live wherever they desire. They become aware of the potential conflicts in values between group consensus and individual freedom. They become aware of limiting factors (space, climate, resources) in natural and built environments.

Time	Where
1 hour	Classroom
Topics	**Materials**
Environmental values, population growth, pollution	Copy of map for each student (see page 54)

LEAD-UP/PREPARATION
None.

ACTIVITY
Step 1
Distribute maps. Ask students to put three check marks on their maps to indicate three places where they would like to live. Tell students to ignore the numbers for now as their meaning will be explained shortly.

Step 2
Teacher asks students to share their choices one at a time while the teacher tallies their responses on the board. "As a result of our tally, you can see that certain areas will have too many of us moving there if we could, and certain other areas might have too few."
Q: Which areas would have too many?
Q: What problems do you foresee for that area if this happened? What benefits?

Step 3
Teacher says, "Every environment presents some sort of problem to the people living there. The numbers on your maps represent the following environmental problems that prevail in that area:
1. Water shortages
2. Air pollution problems
3. Energy is relatively scarce
4. Energy use for heating is relatively high
5. Energy use for cooling is relatively high
6. The population is increasing at such a rate that the social services provided by the government and private agencies are becoming inadequate (schools, police, fire, etc.)
7. Population is declining so that monies collected in taxes are insufficient to pay for social services
8. Farmland is being rapidly converted to residential and business uses
9. Urban areas correlate to high crime areas; urban areas also foster pollution concentrations, and increased energy expenditure for commuting, etc.

Look at your check marks and read the numbers in those states you have selected.

Q: How many of you would now change your minds? How many of you will stay with your original decisions?
Discuss the reasons for changing and for not changing.

continued

FOLLOW-UP

The California numbers seem to have been chosen to represent the problems of the southern area of the state, particularly the Los Angeles basin.

Q: What numbers apply to your own region of California? What numbers apply to the San Francisco Bay Area? to the desert? to the Sierra? to the Central Valley? to the northern-most areas of the state?

Q: What laws have been enacted to improve the quality of life in California? If you had absolute power, what would you do to improve the quality of life in California?

Q: Was the original version of this lesson written before or after the enacting of Proposition 13? How can you tell?

Q: Living near the ocean is desirable to many people. What would result if these areas became overpopulated?

Adapted from *Personal Values and Environmental Issues*

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WHAT WOULD HAPPEN IF . . .

DESCRIPTION
Students generate a list of possible environmental happenings and then list the consequences of those, and the consequences of those, and so on.

OBJECTIVE
C-3. To understand that built and natural environments are continuously interactive and changes in one area of the environment can cause changes in many other areas.

PURPOSE
All things are interdependent, including events. Changes in one part of the environment will have definite effects on other parts. One purpose of environmental studies is to predict possible chains of events.

Time	Where
1 hour	Classroom
Topics	**Materials**
Futurism, energy resources, resource management	None

LEAD-UP/PREPARATION
Much of environmental education curriculum deals in "futures." Prediction is a crucial element of environmental studies. The power to predict upcoming events, to have foreknowledge, has been the subject of many stories and myths. Much of the Bible is concerned with prophecy, as is much of our science fiction and literature.

Q: If you had the power to predict the future, what would you do with the power? Pose this question: Suppose you were handed the newspaper for next Wednesday afternoon. What would you do?

ACTIVITY

Step 1
Generate a list of environmental "supposes," such as those on the following list:

- Suppose the San Andreas Fault was the site of a magnitude eight earthquake tomorrow.
- Suppose the price of wheat doubled tomorrow.
- Suppose U.S. oil companies found a virtually inexhaustable supply of petroleum off the Aleutian Islands.
- Suppose a technological breakthrough was discovered which made it possible to build cars of the same quality at half the price.
- Suppose the U.S. government banned all use of corn syrup as a sweetener or filler.
- Suppose John Muir came back to life.
- Suppose all disco music was magically erased from the world.
- Suppose the Watergate scandal had never taken place.
- Suppose the Battle of Waterloo had the French as victors, etc.

Step 2
Divide the class into small groups and assign each group a "suppose" statement. The assignment is to generate five "then" statements. For example:

1. . . . then all the food labeling would have to be changed.
2. . . . then the companies would have to find some other filler or lose money.
3. . . . then foods would have less sugar in them, and, therefore, probably be better for you.
4. . . . then the farmers who grow corn would have to find other markets or change crops, or go out of business.
5. . . . then dentists wouldn't make as much money, etc.

Step 3
After the "then" statements are completed have them shared with the rest of the class.

continued

Step 4

Have each small group select one of its "then" statements to become a second order "suppose" statement; e.g., suppose dentists don't make as much money. Have them generate five more "then" statements . . . and so on.

FOLLOW-UP

1. Discuss. The Trojan princess Cassandra was granted the power of perfect prophecy by Apollo in return for anticipated favors. When she wouldn't do what he expected he added a small proviso to his gift: that even though she could predict the future perfectly, no one would ever believe her predictions. Are there such people around today?
2. Read *Cat's Cradle* by Kurt Vonnegut. Predict the ending of the novel; what happens when Ice IX gets into the ocean?

NOTES

Social Institutions and Decision-Making Activities

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SOCIAL INSTITUTIONS AND DECISION MAKING

Issues

Western cultures have historically perpetuated two basic themes through their decisions affecting the environment. One is the concept that humans are dominant over nature, and therefore, free to exploit natural resources for their benefit. The other is a concept of stewardship — that humankind has a responsibility to protect all living things and the land, air, and water. The tension between these two themes is often apparent when environmental issues are debated.

Decisions affecting the environment are usually made within our social arenas. Responsibility for the "public good" is shared by political, legal, economic, educational, and religious institutions. An overview of these major social institutions helps clarify the role of each.

Government has played an increasingly influential role in environmental decision making. Enactment of the National Environmental Policy Act of 1969 (NEPA) established the process for giving environmental concerns consideration in governmental decisions. This act instituted the requirement of environmental impact statements, which mandate the consideration of environmental, as well as economic and technological, concerns in the decision-making process. Laws to control air and water pollution and to expand parks and wilderness areas have also legitimized the concern for a healthy environment. Lobbyists have been influential in shaping our government's environmental policy. Groups such as the Sierra Club, Friends of the Earth, and those representing the interests of developers research the issues and take their cases to governmental representatives. These representatives often listen closely to those with a vested interest in an environmental issue.

Our courts have also played a decisive role in the resolution of environmental issues. The environmental impact statements of NEPA resulted in many suits by environmental groups against federal agencies. In discharging their obligation to interpret the law, the courts have clarified the intent of several environmental statutes.

The business and industry sectors of society affect environmental decisions, not only through lobbying efforts, but through economic enterprises that exploit natural resources. A long-standing debate argues the ethical relationship between business and the environment. Should business be expected to voluntarily engage in practices that diminish its profits? Does business have a responsibility to serve the social good of the community? Business and industry have, without a question, a profound effect on the environment. Yet, whether or not their mechanism for making decisions should consistently include environmental considerations is still largely undetermined.

continued

Business and industry affect environmental issues from another perspective: that of the worker. Labor organizations have found that, in recent years, environmental concerns are sometimes in concert with our own. Labor and environmentalists lobbied together for a bill that regulates the use of toxic substances. A tension continues to exist, however, in situations such as the expansion of Redwood National Park. Labor worked hard against a decision to expand the park because it believed it would destroy jobs.

The wave of enthusiasm that accompanied Earth Day in 1970 led many people to believe that educational institutions would be able to provide citizens with the ability to make responsible environmental decisions. Educators have had a difficult time, however, defining environmental education and deciding where it fits into the school curriculum. Also, schools usually **reflect** societal trends rather than set them. It has, therefore, been difficult to establish a future's-oriented curriculum within the existing educational structure.

When religious institutions have participated in the environmental decision-making process it has been mostly through their educational mission. Church organizations such as The American Friends Service Committee have advocated for personal lifestyles that reflect a concern for the environment. Other efforts, such as the Interfaith Center for Corporate Responsibility, have attempted to push churches into a more active role regarding environmental decisions.

Environmental issues are clearly complex. They are directly influenced by a societal concern for economic well-being and the leadership provided by the major social institutions. Each of these institutions must be responsive to social needs and the environment as they work to make decisions that promote the public welfare.

Five concepts have been identified to develop student awareness of Social Institutions and Decision Making. The first addresses the international ramifications based on continuous use of technological/industrial mode. The second addresses (1) the basis for economic prosperity that can be established through more efficient use of natural resources, and (2) the effects that unlimited short-term prosperity can have on long-term goals for ourselves and for future generations. The third concept addresses decision making about the environment — who makes decisions and how they are made. The fourth concept addresses the identification of sources of information about environmental problems and the real and potential influences which they have in helping to resolve these problems. The final concept addresses the nature of the regulations which are now in effect for controlling use of the environment, how regulations are formulated, and the role of individuals in assuming responsibility for participating in the resolution of environmental problems.

NOTES

SOCIAL INSTITUTIONS AND DECISION MAKING

MAJOR CONCEPTS	OBJECTIVES
A. Environmental problems transcend political entities, state and national boundaries, and cultural differences.	1. To understand how technological advancement and industrial expansion throughout the world are creating massive changes in the environment that have worldwide effects. 2. To understand that population growth in all parts of the world is creating an unprecedented demand for the consumption of natural resources. 3. To understand how national self-interests and societal values and ethics influence international collaboration on environmental issues.
B. The goals for every society include economic prosperity which is based, in part, on the consumption of natural resources.	1. To understand that technology for recycling and renewing resources, developing new resources, and discovering alternative uses for existing resources is critical for maintaining and improving our health, welfare, and economic prosperity. 2. To understand how short-term and long-term effects can influence economic decisions related to the use of the environment.
C. Individuals and private groups within our society play important roles in developing public awareness of environmental issues and in monitoring public and private activities in relation to the environment.	1. To understand how interest groups express the values, ethics, and understandings of subgroups within our society. 2. To understand that interest groups are established to participate in the political process and to influence public policy and lawmaking.
D. Educational institutions and communications media are potential sources for the creation of public awareness of environmental issues.	1. To understand that communications media through reporting, advertising, and other programming can widely influence public attitudes about the environment. 2. To be aware that a variety of public and private organizations provide educational programs to influence public opinion about the environment. 3. To be aware of the various avenues which are available for individual expression of concerns about the environment.
E. Environmental law is intended to regulate use of the environment for present and future generations.	1. To understand that governmental agencies at state and national levels monitor the environment, make recommendations for laws, and monitor the implementation of the laws. 2. To understand that environmental laws reflect a great many factors, such as economic consequences to an industry, technological development, and short-term and long-term consequences for the environment. 3. To understand that the effectiveness of environmental law is dependent on the extent to which individuals and groups accept responsibility for the care of the environment.

SOCIAL INSTITUTIONS AND DECISION MAKING OBJECTIVES & ACTIVITIES

		K-3	4-6	7-9	10-12
CONCEPT A	1. To understand how technological advancement and industrial expansion throughout the world are creating massive environmental changes that have worldwide effects.	Students interview elderly people from the community.	Through demonstrations and discussions of air and water movement, students discover how pollution can travel from one place to another.	Students use math and map study to outline the impact of land development on wildlife populations.	Students brainstorm positive and negative effects of off-road vehicles (ORVs). Students create lists for the more responsible use of ORVs.
	2. To understand that population growth in all parts of the world is creating an unprecedented demand for the consumption of natural resources.	Students count the number of people in the last two generations of their families. They discuss populations and the need to share resources.	Students simulate how rich and poor countries try to provide for the basic needs of their citizens.	Students participate in a global meal where 1/3 of the group eats an American meal, and 2/3 eat a Third World meal.	In a simulation game, Malthusian principles are demonstrated.
	3. To understand how national self-interests, and societal values and ethics influence international collaboration on environmental issues.	Through artwork and discussion, students describe and examine attributes of groups.	Students compare the belief systems and resultant behaviors of a Native American group and early settlers.	Students consider several hypothetical public policy decisions on food production from disparate points of view.	In a simulation game, students act as a committee gathered from different nations to erect an environmental monument.
CONCEPT B	1. To understand that technology for recycling and renewing resources, developing new resources, and discovering alternative uses for existing resources is critical for maintaining and improving our health, welfare, and economic prosperity.	Students learn additional verses to the song "It's a Small World."	Students look at long- and short-term effects of choices they make in purchases. Alternative lists are brainstormed.	Students consider packaging and its effect on the environment. They take a poorly designed package and redesign it.	Students design a segment of one community and take into account economic, energy, environmental, and aesthetic considerations.
	2. To understand how the short-term and long-term effects of resource use can influence related economic decisions.	Students sort and examine classroom waste and recycle selected items.	Students devise other uses for common items in a format game.	Students discuss a fictional work related to the use and abuse of natural resources.	Students examine the pros and cons of packaging in the fast food industry and make recommendations.
CONCEPT C	1. To understand how interest groups express the values, ethics, and understandings of subgroups within our society.	Students sort themselves according to physical attributes and opinions.	Students make a list of appropriate behaviors in outdoor settings. They look at them from the viewpoint of various interest groups.	Students role-play a city council meeting in which they must choose to fund only one of three environmental projects.	Students design logos representing interest groups concerned with environmental issues.
	2. To understand that interest groups are established to participate in the political process and to influence public policy and lawmaking.	Students learn about and make models of endangered animals.	Students create a story from facts only with interest groups viewpoints attached.	Students design a coat of arms representing a citizen's group, governmental agency, etc., concerned with the environment.	Students read position papers put forth by groups on the issue of overpopulation of deer in a small California park.
CONCEPT D	1. To understand that communications media through reporting, advertising, and other programming can widely influence public attitudes about the environment.	Students play describing games to see how well they can communicate a simple message. TV ads are analyzed.	Students role-play different propaganda techniques and examine advertisements for bias.	Students collect energy ads, discuss their purpose and effectiveness, and then design an energy conservation billboard.	Students detail some of the techniques used in the media to influence thought and opinion.
	2. To be aware that a variety of public and private organizations provide educational programs to influence public opinion about the environment.		Students write an editorial on land use in a hypothetical locality.	Students analyze environmental education curriculum materials for bias and manipulation.	Students write for their own class, lesson plans reflecting the biases of selected interest groups.
	3. To be aware of the various avenues which are available for individual expression of concerns about the environment.	Students express their feelings about a forest environment through creative dramatics.	Students examine ways of expressing their environmental concerns and then actually "make a statement."	Students choose an issue and write a petition to bring about change.	Students use a model letter form and write to those who have power over an environmental issue.
CONCEPT E	1. To understand that governmental agencies at state and national levels monitor the environment, make recommendations for laws, and monitor the implementation of the laws.	Students examine a classroom problem and the effectiveness of rules.	Students inspect a map showing the land area designated as public parks and open spaces and identify the origins of these designated areas.	Students conduct a mock trial involving thermal pollution of a stream from a nuclear power plant.	Students hold small group meetings to prepare statements on the use of national forest lands for vacation homes.
	2. To understand that environmental laws reflect a great many factors, such as economic consequences to an industry, technological development, and short- and long-term consequences for the environment.		Students take part in a land use planning decision concerning a newly formed lake.	Students simulate an EPA hearing on the use of DDT on the spruce budworm.	Students collect information in a school survey to determine how their school functions, what the power structure is, and who makes the rules.
	3. To understand that the effectiveness of environmental law is dependent on the extent to which individuals and groups accept responsibility for the care of the environment.		Students attempt to equitably divide coastal waters out to a 200 mile (320 km) limit.	Students predict what would happen to a vacant piece of land in the community which was owned in common.	Students analyze the actions of individuals in the environment and make value judgments.

ORVs AND US

DESCRIPTION
Students brainstorm lists of positive uses and negative effects of off-road vehicles (ORVs). Students create lists for more responsible use of ORVs. The banning of their use by citizens is presented as a topic for discussion.

OBJECTIVE
A-1. To understand how technological advancement and industrial expansion throughout the world are creating massive changes in the environment that have worldwide effects.

PURPOSE
To show the effects on the natural and built environments caused by technological innovation, such as off-road vehicles.

Time	Where
1-2 hours	Classroom
Topics	**Materials**
Appropriate technology, transportation, desert	None

LEAD-UP/PREPARATION
Ask students to share any experiences they have had with ORVs, (all-terrain vehicles), ATVs such as dirt bikes, motocross competition, dune buggies, snowmobiles, etc. Share commercial pamphlets and articles on the uses and advances being made with ORVs.

ACTIVITY

Step 1
Hold a brainstorming session with your class to develop two lists, one of the positive uses and possible benefits of ORVs, and the second of the effects of ORVs on the environment.

Q: From comparisons made of the items on these lists, can you make a judgment about whether or not ORVs are a good thing? Should the use of ORVs be restricted? If so, to whom and under what circumstances?

Step 2
Divide the class into small groups and have them analyze the long-term and short-term effects of ORVs on:

- Wildlife
- Air quality
- Plants
- Noise
- employment
- Soil
- Fire danger
- Energy consumption
- Sports
- Entertainment
- Lifestyles (the effect of snowmobiles on the Inuit Eskimo, has been dramatic)
- Safety and rescue operations

Share the results in class discussion of short-term and long-term effects.

Step 3
In small groups, draw up a set of guidelines for the use of ORVs. Address the possibility of a ban on ORVs by local or state governments. Discuss the results with the entire class.

FOLLOW-UP
1. Obtain sets of guidelines published by the ORV associations and by governmental agencies, such as the U.S. Forest Service and the Bureau of Land Management. Discuss similarities and differences between these agency lists and between the agency lists and your class-generated guidelines.
2. Discuss off-road racing in the desert regions of California. Many environmentalists feel that in terms of environmental responsibility, preservation of habitat, soil, plants and so forth, this practice has been very destructive to the region. Yet, off-road racing continues and is apparently growing in popularity as a recreational pursuit. Hold a class debate—Resolved: Off-road racing should be banned in the desert regions of California. Be sure to give your students plenty of time to research all sides of this issue. Suggested sources of materials on the subject include national and local ORV clubs, the State Dept of Parks and Recreation, regional and national environmental groups, and so forth.

IN A FAR AWAY GALAXY, A LONG TIME AGO

DESCRIPTION
Malthusian principles are demonstrated through simulation.

OBJECTIVE
A-2. To understand that population growth in all parts of the world is creating an unprecedented demand for natural resources.

PURPOSE
To demonstrate the principles of population growth rates and resource growth rates.

Time	Where
2 hours, ongoing	Classroom
Topics	**Materials**
Population growth, human ecology, famine	For each group: several sacks filled with hundreds of small pieces of variously colored construction paper; game cards (as outlined below)

LEAD-UP/PREPARATION
Develop the concepts of arithmetic and geometric progressions in the following manner. Select two students to serve as "takers." One will take colored markers from a sack in an arithmetic way, that is, one at a time. The other will take markers in a geometric fashion, that is, doubling his/her total ech time. Teacher says the word "take" every 15 seconds. It will soon be impossible for the second student to take any more markers. Before the taking begins, the class may be asked, "How many 'takes' would it take before the operation becomes impossible?" Students may also be asked to calculate how many "takes" would occur before the geometric progression reaches a number larger than a thousand (11); larger than a million (21).

ACTIVITY
The 18th century British philosopher scientist, Robert Thomas Malthus, is best remembered for his contribution of a theory of population wherein he postulated that whereas population increases geometrically, resources, especially food, can only be made to increase in an arithmetic manner. The following game will show the consequences of the Malthusian Laws on an imaginary society.

Step 1
Divide the class into several small groups, each with the following materials:

1. A large supply (hundreds) of small pieces of variously colored construction paper.
2. A set of 20 FRACTION cards, each with a fraction of one-half or less, written on one side (½, ⅓, ¼, ⅛, 1/16, etc.).
3. Another pack of 20 cards called EVENT cards distributed as follows:
   - Three say TECHNOLOGICAL ADVANCE, IGNORE DISASTER; the rest say NO HELP.
   - The game leader (teacher) also has a set of cards called DISASTER and BREAKTHROUGH cards. There are 10 DISASTER and BREAKTHROUGH cards; two say WAR, two say FAMINE, two say DISEASE, two say MIGRATE TO THE NEAREST PLANET, and two say CUT BIRTHRATE IN HALF.
   - All cards are kept in their respective piles and are face down.

Step 2
The Game. Each group of students represents a planet in a solar system far away. They each start with ten persons on the planet represented by ten pieces of paper. The teacher says, "Your world is at peace, there is no disease and there is plenty of food. It is a good time to have children. Increase your population, two children per couple." Teacher instructs the groups to add paper pieces until the total population reaches 20, or in other words, doubles. Teacher says, "There's still enough food, things are O.K. A few people die in accidents, a few catch diseases. Remove a few. Now, reproduce again."

continued

Students are instructed to double the population. Teacher says, "Things are getting scarcer now. Some people are stealing food. There is some overcrowding, some pollution, some die of disease. Reproduce." Students double the population. This is now the third generation. Teacher picks a DISASTER and BREAKTHROUGH card every third generation.

If a WAR, FAMINE, DISEASE or MIGRATE card is chosen, each group picks one FRACTION card and one EVENT card. The FRACTION card tells the group by what fraction to reduce the population as a result of the disaster or migration. The EVENT card which reads TECHNOLOGICAL BREAKTHROUGH saves the population from the disaster. The NO HELP cards do nothing. If the CUT BIRTHRATE card is chosen, each group reduces for one generation.

The game is played until all the DISASTER and BREAKTHROUGH cards are played or until the population numbers get dizzying. *Note:* Different colors of paper can be made to represent different numbers of people; for example, blues are ones, reds are tens, yellows are 100 people, and so forth.

Step 3

Have each small group total the number of people it has left at the end of the game. Put the group name and its resultant number on the board.

Q: O.K., who won? Ask for students' criteria in deciding who won.

Q: Did any group really win?

Step 4

Q: How real is this set up, that is, how well does the game model population growth on earth?

Q: What improvements can you think of to make the game more realistic? (Birthrates vary with, for example, the technological state of the society, the higher, the fewer. Birthrates do not equal survival rates, etc.).

Q: How does culture enter into the question of population growth? What about religious beliefs? What about parents' desire in some cultures for security in old age, as represented by having large numbers of children?

Q: The only resource that was mentioned in the game was food. What other resources become scarce as population increases? Do humans have a need for solitude, for wilderness, for varied experience?

FOLLOW-UP

1. Compare the population densities of developed countries, such as the United States and West Germany, with lesser developed countries, such as India and Bolivia. Compare their birthrates, death rates due to starvation and disease, level of health care, frequency of wars, and ownership of natural resources.
2. Discuss. Technology has helped relieve the pressures of increasing populations in developed countries by making resources more accessible. How has this affected lesser-developed countries? Discuss the global implications if this pattern of technological inequality continues. Can developed countries maintain their standard of living regardless of increased global population? How does their standard of living influence the standard of living of lesser developed countries?
3. Discuss the cultural and environmental implications of family planning. Some people consider having few or no children as a duty they owe to the environment. Yet, in some countries, a farmer may need several family workers in order to scrape out a living from the land. Still others consider it immoral to interfere in natural reproductive functions. Is family planning a viable solution to population problems in all cultures? How else might we relieve population pressures?

MONUMENTAL DISCUSSION

DESCRIPTION
A simulation game in which the students are a committee gathered from different nations and are given the responsibility of erecting a monument to the environment.

OBJECTIVE
A-3. To understand how national self-interests and societal values and ethics influence international collaboration on environmental issues.

PURPOSE
To show that societal values, ethics, and consciousness affect local, national, and international policies with respect to the environment.

Time	Where
2 hours	Classroom
Topics	**Materials**
Environmental values, international, interdependence	Drawing paper, pencils, felt markers

LEAD-UP/PREPARATION
Students will be better able to represent the nations listed below if they research each nation's general attitude and political stance on contemporary environmental issues. Discourage stereotyping.

ACTIVITY

Step 1
Divide your class into ten small groups. Assign each group one of the following nations:

United States	Canada	Soviet Union
France	Japan	Bolivia
Iraq	Nigeria	New Zealand
People's Republic of China		

Step 2
Present the following premise and assignment:
The United Nations Committee on the Environment has budgeted $2 million to erect a monument to the environment at its International Headquarters in Geneva. It has come to the ten nations (listed above) to solicit plans for the monument.

Each nation will submit design plans for the monument to the committee. (The teacher acts as the committee.) Without resorting to stereotypes, each nation should submit plans based on its national consciousness of the environment and based on its ethical positions, its values, and its economic stake in the environment, and on the major international environmental issues of the day. (For example, the Soviet Union may design a monument which has as its basis the theme "Environmental Issues Are Part of the Class Struggle" and which would have no mention of whales.)

Step 3
The class as a whole, still divided into national characters, must select one design. Allow the class to form factions, to negotiate for changes, and to threaten and cajole disagreeing factions, even to pull out of any further discussion (with major international tensions resulting). Finally, one design or modified design must be accepted.

continued

Q: How meaningful is the selected design? Does it address environmental problems? Does it address problems of overpopulation; the reasonable needs of developed nations; the aspirations of the Third World? Does it promote international cooperation through its message, or does it only point out our differences?

FOLLOW-UP

1. Discuss. How well do nations cooperate on environmental issues? Assign international issues for further study; for example, responsibility for pollution of international waters: ocean mining; freedom of the seas; air pollution of one nation's air space by another; marine mammal exploitation; international trade in drugs; international trade in skins of endangered species and others.
2. Design an international environmental park. Design a California environmental park as a simulation. Factions should include Sierra Club, petroleum industry, forest products industry, Department of Fish and Game, Los Angeles Chamber of Commerce, Central Valley farmers, migrant workers, etc.

DESIGN WITH NATURE

DESCRIPTION

Students design a segment of one community by taking into account economic, energy, environmental, and aesthetic considerations.

OBJECTIVE

B-1. To understand that technology for recycling and renewing resources, developing new resources, and discovering alternative uses for existing resources is critical for maintaining and improving our health, welfare, and economic prosperity.

PURPOSE

To show that economic choices concerning the environment must be made with regard to their short-term and long-term outcomes.

Time	Where
1-2 hours	Classroom
Topics	**Materials**
Economic development, human ecology, land use planning	Art materials for small groups

LEAD-UP/PREPARATION

- Have your students find out who planned your community. Perhaps your community just grew without planning, as many of our communities did.
- Have your students find out about local zoning ordinances.
- Have your students do some research into the origin of street names in your community. This research may lead them into a detailed history of the growth of your community, or into an interesting look at the philosophies and opinions of your town's founding mothers and fathers.

ACTIVITY

Step 1

Join your students in brainstorming a list of reasons why trees, shrubs, and other greenery are considered important to many urban dwellers. Some of the reasons might be to help filter air, to help muffle noise, to provide beauty and shade, and to increase ecological stability and diversity.

Step 2

Ask students, working individually or in small groups, to design a small residential area within a larger community. In making their designs, they might consider factors such as:

- Economics (is the plan practical?)
- Number and size of lots
- Ratio of houses to open space
- Environmental impact
- Educational facilities
- Privacy of residents
- Number and size of green areas
- Placement of vegetation
- Energy efficiency
- Water supply

Step 3

After some evaluation and discussion of their designs, encourage the students to make revisions of their plans. Students also could compare their plans with those drawn for an actual housing development in their community, perhaps even talking with the architect who did the plans.

FOLLOW-UP

1. Conduct the above activity to design commercial or industrial areas within a community.
2. Design an entire model community.
3. Find out about local street tree ordinances.

Adapted from *Project Learning Tree*

AND A SIDE ORDER OF PAPER

DESCRIPTION

Through observation of the practices of the fast food industry, especially with regard to the packaging process, the students examine the pros and cons of disposable packaging and make recommendations to improve commercial practices.

OBJECTIVE

B-2. To understand how the short-term and long-term effects of resource use can influence related economic decisions.

PURPOSE

To show that consumer decisions have far reaching economic and environmental consequences. One consumer issue is recycling.

Time	Where
45 minutes in class	Classroom
1 hour homework	Local fast food restaurant
Topics	**Materials**
Renewable resources, appropriate technology, economics	Interview sheet (see Lead-Up/ Preparation)

LEAD-UP/PREPARATION

Read the following to the class:

"The take-out, fast-food industry has a big appetite for natural resources. For example, it typically uses hamburger wrappers; boxes for the wrapped hamburgers; cardboard trays for the bag and the box and the wrappers; napkins; straws wrapped in paper; salt, pepper, sugar, and powdered cream in paper packets; coffee cups from petroleum-derived plastics or paper; soft drink cups. All the packaging is frequently discarded within 15 minutes after its contents are consumed; this practice contributes to the country's solid waste problem."

continued

Ask the students to make up a questionnaire to be used when they interview a fast food restaurant manager. Sample questions are:

1. What items does your establishment use for disposable packaging, and from what renewable and nonrenewable resources are these products derived?
2. How many of each item do you use per (insert time period)?
3. What companies supply these items?
4. Why do you use disposable materials?
5. Do you think you are properly packaging your products? (Remember, you want to keep the restaurant manager friendly, so be careful how this question is phrased!)
6. What percentage of the total cost of your product does the packaging represent?
7. Would it be possible for your restaurant to operate without disposable packaging?
8. How many employees do you have? How much is your total payroll?
9. Where and how do you dispose of your restaurant's solid waste (for example, landfill, incinerate, recycle, etc.)?

ACTIVITY

Step 1

Divide the class into small groups. Ask each group to survey a local fast-food restaurant to find out the quantity of each type of disposable packaging it uses in a given period of time, such as a week or a month.

Step 2

When students have completed their interviews and tabulated their data, you might explore some of the following questions with them:

Q: What were the principal reasons given for the use of disposable packaging?

Q: Are any of the disposable items used by fast-food outlets produced locally? If so, how many jobs are dependent upon sales of these products? (Don't forget printing, transportation, manufacturing of machines to print, making paper, etc.)

Q: If fast-food restaurants made changes to eliminate disposable packaging, who, if any, might lose his/her job? Could it be possible to retrain any affected personnel, rather than simply eliminate his/her position?

Q: How might the alternatives affect the cost and convenience of take-out food?

Q: What price do we pay for the convenience of fast-food restaurants and, in your opinion, is the convenience worth the price?

FOLLOW-UP

1. Students might determine major categories of natural resources used, not just limiting their study to packaging and use of disposable materials, but other uses of natural resources and products in the fast-food industry. Renewable and nonrenewable resources could be identified as part of the analysis.
2. Suggest that students explore use of natural resources by other restaurants. Do these other restaurants appear to use natural resources as efficiently, more efficiently, or less efficiently than fast-food restaurants?

Adapted from *Project Learning Tree*

THE LOGICAL LOGO

DESCRIPTION
Students design logos representing interest groups concerned with environmental issues.

OBJECTIVE
C-1. To understand how interest groups express the values, ethics, and understandings of subgroups within our society.

PURPOSE
To show how interest groups express the values and ethics of subgroups in our society.

Time	Where
2-3 hours of class time spread over a week or two	Classroom
Topics	**Materials**
Environmental ethics, environmental values	Magazines and newspapers, art paper, felt markers, or crayons

LEAD-UP/PREPARATION
Have your students search the newspapers and magazines for corporate, governmental, and citizens' groups logos.
Q: What do these logos express to you about the organization they represent?
Q: Who do you think designed the logo?
Create a logo bulletin board, collage, or mobile.

ACTIVITY

Step 1
Brainstorm a list of corporations, government agencies, and citizens' groups which are involved in environmental issues. Such a list might include some of the following: Department of Interior, Chevron U.S.A., Sierra Club, World Council of Churches, Citizen's Party, Green Peace, The Tree People (Los Angeles), Friends of the Urban Forest (San Francisco), National Rifle Association, Caltrans, etc.

Step 2
Have each student choose one group for which s/he will prepare a logo. The logo should be a promotional one, that is, should present the group in the most favorable light. When the logos are finished, label them and put them on display. You may present them to the class one by one and have the class members guess which group is represented by each one.

Step 3
Each of the groups on your list most probably has groups working against its aims. Have the students now pretend that they are an "enemy" group. With this in mind have them design "anti-logos" for their group.

Step 4
Have your students contact their chosen group by mail. Analyze the return mail for the use of logos or promotional artwork.
Q: In your opinion does your group's logo represent the group fairly? What distortions do you see? How are environmental issues represented by the logo or elements of the logo?

Step 5
Now that students have gathered information about the group (after corresponding with it and after discussing its promotional and informational materials in class), have them redesign their original logos to give a clear and fair representation of the group. Compare with the originals and with the anti-logos.

FOLLOW-UP
1. Have students design a flag for their group's public relations department. Ask the group to comment on the designs and the thoughts expressed in them. Analyze the group's responses.

THE BAMBI PAPERS

DESCRIPTION
Students read position papers put forth by groups on the issue of the overpopulation of deer in a small regional park in California. The students are asked to make statements about the future of the deer herd and also about the role of interest groups in determining policy.

OBJECTIVE
C-2. To understand that interest groups are established to participate in the political process and to influence public policy and lawmaking.

PURPOSE
To show that a variety of organizations participate in and try to influence the political process on environmental issues.

Time	Where
1 hour	Classroom
Topics	**Materials**
Wildlife, environmental values, environmental legislation	Per student: A copy of "The Bambi Papers" (see page 73)

LEAD-UP/PREPARATION
Define "interest group." Have the students generate a list of interest groups concerned with the environment.

Q: Can a government agency be considered an interest group? Is one of its functions influencing legislation? (Yes) Give examples. Prepare a copy for each student of "The Bambi Papers" on the next page.

ACTIVITY
Step 1

Select one student to read "The Bambi Papers" to the class. Before the student begins, be sure to make clear to the class that "The Bambi Papers" are a fictional account of a possible environmental problem, and be especially certain to state that much of what is written is done for humorous effect and also deals in stereotypes. See if your students can pick out the stereotyping. Ask them to what extent the stereotypes are true and to what extent they represent gross distortions of the truth.

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The Bambi Papers

—From the Desk of Ben Grant, President of the Friends of the Small.

To Whom It May Concern:

We at the Friends of the Small in no way tolerate the plan to hurt, maim, and kill defenseless deer and their baby fawns. The cruel and inhumane approaches recommended by certain other parties—that is, slaughter by high-powered rifle or by reintroduced coyote—are unconscionable. We shall resist these plans with every resource at our command! Can you imagine taking your children to the Pattie Regional Park and seeing a pack of ferocious coyotes attacking a baby deer, ripping its throat, and devouring its innards? No! It must not be! We recommend that the deer be left alone, and if that cannot be, the excess deer should be moved to other parks and open areas where there are presently no deer. We reject the report of the U.S. Department of Deer. They are being influenced by outside forces.

—From the Desk of Robert Alan, Chairperson of the Mountainperson Club.

We all know that there are certain natural truths which we as a species have violated. We have sown poorly and harvested all. The five square miles of Pattie Park must be protected from all human incursion. On our last backpack to the top of Cameron Crag, we recorded large amounts of litter and hundreds of starving deer. The Park cannot support the deer because of the tampering of humans. Any plan to cull the herd now is simply more tampering. We are not wise enough to know what to do. We must stay out of it. Nature will find a way.

—From the Gun Room at Twelvepoint Lodge, Bob Hawkins, Manager.

Everything was fine twenty years ago. There were enough deer to go around, and there were good bucks and a good selection of does for meat. Soon after the park was established, we started getting a lot of people nosing around and counting predator species and making rules and really interfering with the way it has always been here. Now the deer are starving, the plant life is all eaten away, there are no predators at all (the ones that there were all moved down slope and started attacking the farm stock). It's a pretty poor situation. The deer are dependent on the tourists for handouts and on their garbage.

—U.S. Department of Deer Research and Development, Colin Young, Asst. Director. It is the consensus of our staff of wildlife managers that the present ongoing study entitled Deer; *USDODR&D 543.78/81*—Pattie Regional Park, California, PROJ. Dir. L. Laton GS-14, needs more work. Our results to date, though few, are significant.

1. Deer do not move well.
2. Deer do not adapt well to new places.
3. Deer like to stay where they are.
4. It costs a lot to move deer, and they most often die if moved.

Recommendations: More study is needed.

—The Citizen's Group for the Preservation of the Deer of Pattie Park, Barbara Porter, Director.

As cruel as it may seem, we recommend a controlled shooting of a large portion of the deer herd in Pattie Park. Government studies (after years of work) indicate that the successful removal of excess deer from Pattie Park is prohibitively expensive and would most probably result in the death of most of those moved. The present situation has been ruinous not only to the deer—causing starvation and degeneration of the herd—but it has also been ruinous to those of us who use the park for personal and family recreation and to the local farmers and homeowners. A controlled hunt seems the only solution. We recommend that the state conduct a controlled hunt which will ensure a breeding population and which will enable the plant life to recover. We also recommend that a predator population of wild large cats and coyotes be introduced into the park and protected from hunting so that a balance may be reinstated.

continued

Step 2

Q: What is an interest group? What sorts of interest groups are represented above?

Q: Which interest group has the "right" solution? Is there a right or wrong answer to most such problems?

Q: How many of you changed your minds on the issue as more facts and more opinions were aired? Are interest groups a good thing? (Yes, they bring out varied opinions and facts.)

In the above, find a fact that was interpreted one way by one group and another way by another group. What does this tell you about the nature of facts?

Step 3

Discuss: Environmental issues are very emotional ones. Facts often get lost in emotional messages. Many decisions on environmental issues are made on an emotional basis.

FOLLOW-UP

Check "The Bambi Papers" thoroughly, word by word and phrase by phrase, for bias and emotionally charged language. Often environmental issues are drawn along liberal and conservative lines. Underline conservative statements in blue and liberal statements in red. Is there as much of one color as another in "The Bambi Papers"? Do you detect a bias on the part of the real writer of "The Bambi Papers"? Underline moderate statements in green. Does this change your appraisal of the point of view of the writer?

I ONLY KNOW WHAT I READ IN THE PAPERS

DESCRIPTION

Students detail some of the techniques used in the media to influence thought and opinions.

OBJECTIVE

D-1. To understand that communications media, through reporting, advertising, and other programming, can widely influence public attitudes about the environment.

PURPOSE

The student details some of the techniques used in the media to influence thought and opinion.

Time	Where
1-2 hours classtime Student time	Classroom
Topics	**Materials**
Media, energy, environmental ethics	None

LEAD-UP/PREPARATION

None

ACTIVITY

Step 1

Have your students search newspapers and periodicals for articles and ads concerned with energy. Have the students extract from the articles words or phrases that they believe to be emotionally charged. The teacher may give some examples to start. List selected words and phrases on the board.

Step 2
Ask each student to write the most emotionally charged article s/he can, using as many of the listed words and phrases as possible. Ask your students to share their results with the class.

Step 3
Class discussion.
Q: Is your news article a true representation of the facts involved?
Q: Is your news article fair? If not, to whom is it unfair?
Q: Are there any times when writing an unfair article might serve a good purpose?
Q: Why do writers use emotionally charged words?
Q: Would your energy article be read one way by an environmentalist, in another way by an industry representative, and in yet another way by the average citizen?

FOLLOW-UP

1. Using only advertisements put out by oil companies and public utilities, create an energy ad bulletin board. Have your students rate each ad on its:
   - Attractiveness
   - Factual content
   - Believability
   - The value system it represents

2. Devise some evaluative scale, perhaps a scale from one to ten. Rate and compile the results for each ad. Lead a class discussion on the results:

Q: Which is the best ad? Why?
Q: Why do you think energy companies have such active ad campaigns?
Q: What *other* groups try as hard to get their points across?
Q: How do environmental groups get their points across?
Q: Are there other "influencers" in our society?

Adapted from Project Learning Tree and Decisions in Energy

PLAN IT OF THE APES

DESCRIPTION
Students write for use in their own class lesson plans reflecting the biases of selected interest groups.

OBJECTIVE
D-2. To be aware that a variety of public and private organizations can use educational programs to influence public opinion about the environment.

PURPOSE
To show that a variety of public and private organizations can use educational programs to influence public opinion about the environment.

Time	Where
1-2 hours	Classroom
Topics	**Materials**
Energy, education	A sample lesson plan for each student

LEAD-UP/PREPARATION
Share this lesson plan form or some other plan of your preference with the class. Outline the essential parts for the students. Discuss how you prepare your lessons; mandated curricula; teacher-made materials; your training in research and idea generation; how you share your ideas with your colleagues, and how they reciprocate in kind.

continued

ACTIVITY

Step 1

Assign each student one of the lesson plan titles below:

- Energy for the Future
- Cleaning up Your Community
- Planning a Park
- Wilderness Adventure
- Recycling for You
- International Problems
- The Story of a Fish

Step 2

Now, assign each student the role of lesson plan writer working for one of the following organizations which prepared materials for use in the classroom:

- Department of the Interior
- Major Oil Company
- Public Utility Company
- Internationally Known Environmental Organization
- Major Lumber Company
- National Sportsmen's Association
- Society of Scientists

Step 3

Give the assignment. Each student is to prepare a lesson plan with the assigned title, pretending that s/he is working for the organization assigned. The teacher should start one on the board as an example.

Discuss:

Q: What idea are you trying to get across?

Q: Who is your audience?

Step 4

Once the lesson plans are finished, have the students who wrote lessons with the same title—but for different organizations—compare their lesson plans.

Step 5

Class discussion. Ask:

Q: How interesting are your lesson plans to students? To teachers?

Q: What is the message your organization is trying to get across to school populations? How well will the message of your organization be understood by the audience?

Q: How well hidden is the message? You just cannot come out and say that Blottos are good for you, so eat 'em! No one will go for that.

Q: When you compared your lesson plan with those of your classmates, were you able to spot their biases? Could you easily tell for whom they were working? What biases can you spot in *this* lesson plan?

FOLLOW-UP

1. Search out materials in your classroom which have a point of view or which have something to sell. Are all of those materials sneaky or bad? Which ones are better than others? Why? Are these the same ones you happen to *agree* with? Why are these materials used in your school? Do you think teaching materials should be examined for bias before they are used?
2. Make the book, *Hucksters in the Classroom*, available to your students.

A LESSON IN LETTER WRITING

DESCRIPTION
Students use a model letter form to learn how to write an effective letter to those who might have an effect on the outcome of an issue of importance to the environment. An actual letter-writing campaign is planned.

OBJECTIVE
O-3. To be aware of the various avenues which are available for individual expression of concerns about the environment.

PURPOSE
To show that individuals do have avenues of expression for their concerns on environmental issues.

Time	Where
2 one-hour periods	Classroom
Topics	**Materials**
Environmental legislation, environmental values	Model letter form (see below)

LEAD-UP/PREPARATION
Prepare a copy of the model letter form for each student.

MODEL LETTER FORM

1. Use stationery or 8½" × 11" white paper.
2. Leave wide margins at top, bottom, and sides.
3. Letter parts:
   a) Date
   b) Name and address of political person
   c) Salutation
   d) Body: single space
   e) Closing
   f) Signature
   g) Typed name and address

a. February 10, 1982

b. The Honorable Angela Quartiroli
United States Senate
Washington, D.C. 20015

c. Dear Senator Quartiroli:

d. Our environment xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

I urge you to xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

e. Sincerely,

f. Starr Parkhurst
100 Elm St.
Berkeley, CA 94707

ACTIVITY

Step 1
Distribute the model letter form. Discuss the parts of the letter.

Step 2
Have each student write a model letter on some environmental concern of his/her choice. Ask the students to share their letters and comment on the form and the content.

Q: Will this letter actually be read by the person to whom it is addressed?
Q: Will it first be screened by a staff member?
Q: How effective is the language you have used? Are your arguments convincing and well supported with evidence? Have you appealed to the emotions and to a sense of fair play? Do you use an argumentative, accusatory, or threatening tone?

continued

Q: Have you made concrete suggestions for the solution of the problem as you see it?

Step 3
Have the students plan an actual letter writing campaign on some issues of concern to them in the environment. Have them suggest who might be the best person, persons, or groups to contact.

Step 4
Write!

FOLLOW-UP
What other forms of personal expression are available to the citizen? Which are the most effective?

VACATION HOMES

DESCRIPTION
Students hold small group meetings to prepare statements on an issue of use or restriction of use of national forest land for vacation homes.

OBJECTIVE
E-1. To understand that governmental agencies at state and national levels monitor the environment, make recommendations for laws, and monitor the implementation of the laws.

PURPOSE
To demonstrate that environmental policy and law are implemented through agencies established for that purpose, and that such agencies often have to make trade-offs which they believe to be in the best interest of the parties involved.

Time	Where
1-2 hours	Classroom
Topics	**Materials**
Forests, land use planning, environmental legislation	Scenario (see below)

LEAD-UP/PREPARATION
Prepare copies of the scenario below describing a hypothetical situation and distribute them to the students:

There are 50 summer cabins on Lincoln National Forest land along Bear Creek. The sites for these cabins were leased to private citizens 30 years ago. At that time, there was very little forest recreation in this area.

Since then, the nearest city has grown tenfold. Recreation in the Bear Creek area is almost 20 times what it was 30 years ago.

Some people feel that those 50 cabins should no longer be permitted to dominate that area of Bear Creek and that the land belongs to all of the people.

Should 50 families have Bear Creek to themselves or should their

leases be terminated and the cabins removed? Should the cabin owners be allowed to remove the cabins? Should they be reimbursed for their value?

ACTIVITY

Step 1
Divide the class into three groups:

1st group: Three or four students will represent the Forest Service Advisory Board. They will conduct a hearing and come to a decision.

2nd group: Half of the remainder of the class will role-play the cabin owners.

3rd group: The other half of the remaining students will represent the general public.

Step 2
Distribute the scenarios.

Step 3
Allow the "cabin owners" and "general public" time to prepare testimony stating their reasons for either renewing the leases or abolishing them. During this period, the U.S. Forest Service Advisory Board should plan the hearing procedures, specifying who testified, for how long, and in what order.

Step 4
When all groups feel they are ready, the hearing should be convened. After the testimony has been presented and opportunity for rebuttal provided, the Advisory Board should meet briefly to reach a decision. It should then return and report its decision to the entire class, explaining the reasons for its decision.

FOLLOW-UP

1. Discuss the means by which such land-use decisions are made in your local region.
   Note: It is useful to have the classroom arranged as a hearing room for the meeting or to find an available auditorium.
2. Have students research the land use policies and history of the controversy surrounding the Lake Tahoe Basin.

Adapted from Project Learning Tree

WHO RUNS THIS PLACE?

DESCRIPTION

Students collect information in a school survey to determine how their school functions, what the power structure is, and who makes the rules.

OBJECTIVE

E-2. To understand that environmental laws reflect a great many factors, such as economic consequences to an industry, technological development, and short- and long-term consequences for the environment.

PURPOSE

To encourage students to be aware of the rules and laws in their surroundings and to play an active role in improving the situation, if needed.

Time	Where
Two 45-minute periods	Classroom and school
Topics	**Materials**
Ecology, environmental ethics, recycling	Question sheet for each team of 2

LEAD-UP/PREPARATION

Introduce the idea of a closed system and discuss how a school could partially operate on a closed-system approach. What rules close the system? Who controls the closed aspects of the school?

Distribute question sheet containing the following environmental questions. Also, for each question, ask "Who is in charge of this?"

a. Does the school have pop machines? Are they returnable bottles?
b. What happens to the garbage from the cafeteria after lunch?
   What could be done with the paper?
   What could be done with the wasted food?

continued

c. Does your school use washable plates, silverware, and glasses? If not, what does it use? Are these utensils biodegradable? From renewable resources?
d. Is school trash burned on the site? If not, what happens to it?
e. How many teachers run dittos on both sides? Ask ten teachers and figure the percentage.
f. How many teachers use scrap paper for short quizzes or other activities in the classroom? If they do not, ask their reasons. Ask ten teachers and figure the percentage.
g. Do any teachers have a box for scrap papers to be tossed and taken to a recycling center?
h. Does the office use recycled paper? If not, ask why.
i. Some schools use scrap paper to make scratch pads. Does your school?
j. Does your school have any trees on the site? How many? What kinds? Would you like to see more trees planted? Where? For what reasons?
k. Does the school site have lawns and shrubs?
l. Is it realistic to try to make a school a politically open system? Why or why not?
m. Name some things that schools use which are not kept on the school site and most likely could not be recycled.
n. Mention some things which have to be brought into the school which the school cannot provide for itself.
o. Is it possible for an entire nation to be a totally closed system? Name some things which it cannot keep within its boundaries—things which are shared by all nations.
p. Name some things which the United States must get from outside its borders.
q. What is the only physical unit (area) which can be called an actual closed system?

ACTIVITY

Step 1

Hand out question sheets. Allow students to work in pairs outside the classroom to gather as much information as possible. Encourage them to ask people questions. This is a high risk activity.

Step 2

Allow students to report their findings to the class the next day. Follow the reports with a discussion:

Q: Are there some ways the school operates that you don't understand?
Q: What changes could be made to minimize this?
Q: What steps would be needed to carry out a new policy or procedure?
Q: What did you learn about the school or the people in the school that you did not know?

Question sheet adapted from *Environmental Education Activities Manual*

I GOTTA BE ME!

DESCRIPTION
Students analyze actions of individuals in the built and natural environments and make value judgments.

OBJECTIVE
E-3. To understand that the effectiveness of environmental law is dependent on the extent to which individuals and groups accept responsibility for the care of the environment.

PURPOSE
To show that environmental rights of the individual are protected to the degree that individuals assume responsibility for the environment.

Time	Where
1-2 hours	Classroom
Topics	**Materials**
Aesthetics, stewardship, environmental ethics	Camera and film or drawing paper, crayons or felt pens

LEAD-UP/PREPARATION
Initiate a discussion on the effects that human actions can have on the environment.

Q: Are most such effects good or bad for the environment? Deal with ambiguity!

ACTIVITY
Step 1

Have the students comment on the following actions:

- A person who is really into music plays his radio very loudly in order to share it with everyone else in Griffith Park.
- A person in love picks flowers from a meadow near Donner Lake.
- A curious person digs up a badger hole in Stanislaus National Forest.
- A clean person burns his trash in a San Diego suburb.
- A movie director adds rocks and bushes to a scene in a movie s/he is shooting in the Yosemite Valley. S/he paints the rocks in the scene.
- A person who is against offshore drilling in California climbs the north tower of the Golden Gate Bridge on a busy Sunday afternoon in protest.
- A person, finding a litter basket in a Eureka park that is full, puts his ice cream wrapper in his pocket.
- A person whose car needs a muffler and a tune-up takes a drive along the Big Sur coast.
- A person in scuba gear goes abalone hunting off Santa Cruz.
- A family tows a motor boat behind its motor home on the highway to Lake Tahoe.
- A hiker in the Trinity Alps walks 30 yards (30 meters) off the trail and carves his name in a tree.

Step 2

Have each student select one or more of the actions to illustrate. One way to do it would be to recreate the action and have a picture taken. Another way would be to draw a picture of the deed, or act it out for the class.

Step 3

Have each student then illustrate the results of the deed in detail; e.g., the tower climber caused a traffic jam, caused rescue teams to risk their lives, and was eventually arrested. He did little to further publicize or forward his cause.

Step 4

Have each student illustrate a counter-deed; e.g., the man organized a letter-writing campaign against offshore drilling.

FOLLOW-UP
1. Each student can design a promotional campaign to illustrate the good and/or bad outcomes as determined above. Have the students brainstorm some more actions showing how individuals interact with the environment in responsible and irresponsible ways.
2. Make a bulletin board. Add newspaper clippings showing individual/environmental interactions.

Energy and Environmental Resource Management Activities

ENERGY AND ENVIRONMENTAL RESOURCE MANAGEMENT

Issues

The ultimate goal of resource management in the present-day context is to increase the productivity of our environment to meet the needs of an expanding population. On the underside of that optimistic outlook there is another equally urgent goal to ensure our survival. One concept emphasized in the section of the Natural Environment is the importance of habitat for the survival of any species of wildlife. In this section, that concept is applied to the human race and particularly to those of us who share in that part of the planet called California.

We are all familiar with the type of resource management that results in building a dam to provide for a continuous flow of water to an urban area, or a public works canal that carries water to farmlands for irrigation. And most of us have experienced the need to conserve water or gasoline when there are shortages. But after the dam was built, we discovered that fish no longer came up the rivers to spawn, and when the farmlands were irrigated, we discovered that salinization due to poor drainage was reducing the productivity of the land. One attempt to control the environment and manage a single resource led to other problems and the need for managing other resources. When the water or gasoline shortage abated, we knew we were still vulnerable and our lifestyles could be affected almost any time by another scarcity. Along the path of these experiences, the meaning of resource management has changed from a one-problem approach to a holistic outlook and a tacit recognition that humans are, in fact, only members of a biotic team.

A holistic approach to resource management is based on the recognition of at least two realities about our environment. One is that the environment is infinitely complex and any system for managing its resources must take into account all the ramifications that ensue from any intervention into its operation. Another is that we are confronted with the reality that we are approaching the economic limits of nonrenewable resources such as oil and gas. We face the challenge of finding a new basis for continued prosperity and a satisfactory quality of life. The answer lies in an increased reliance on and caring for renewable resources, such as forests, fisheries, farm soils, and rangelands. Underlying this shift in emphasis is another recognition that our natural resources constitute our true wealth now and for future generations.

Four concepts have been defined for developing students' understanding of resource management. The first is concerned with conservation, one way in which the real supply of resources can be increased by consuming less. The second is concerned with renewing resources, the problems involved in establishing continuously renewing supplies of resources. The third is concerned with understanding past — and present-day models for resource management and the lifestyles that include this as part of everyday living. The fourth is a description of the model for resource management that is being developed in California through the state government. A selected number of resource management departments are described in terms of the long-range problems with which they are dealing. Their particular departments were selected because their long-range planning needs so clearly exemplify the range of environmental problems which our society, in general, is confronting. Other departments within the Resource Agencies are also described more briefly and a number of educational materials that are available from each agency are listed and described. Detachable, addressed postcards for ordering materials or requesting information from each department accompany the materials list.

ENERGY AND ENVIRONMENTAL RESOURCE MANAGEMENT

MAJOR CONCEPTS	OBJECTIVES
A. There are a number of historic and present-day models which can be used in developing resource management programs.	1. To understand how groups of people historically have managed scarce natural resources for their collective benefit. 2. To be aware of the key factors in the world today that have contributed to the decreased availability and quality of all natural resources.
B. Conservation is the most immediate way of increasing the real supplies of a natural resource. Conservation practices focus on more efficient uses of natural resources.	1. To be aware of the importance of non-renewable resources for maintaining our lifestyles. 2. To be aware of economic, legislative, social, and other means that can be used in promoting the conservation of resources. 3. To become aware of the potential for recycling and reclaiming resources.
C. Some resources are renewable and can be maintained so they will provide consistent and continuous supplies of resources as they ar needed.	1. To be aware of the role of technology in renewing and recycling resources. 2. To understand that through technology, we expand the range of resources which we use in meeting our needs and desires. 3. To be aware of the complexity which often exists in resource management, especially when intergovernmental and intercorporational cooperation is required. 4. To understand the necessity of long-range planning for resource management in relation to the assessment of future needs.
D. Resource agencies and their departments maintain the productivity of our natural resources into the future.	See California State Resource Agencies section.

ENERGY AND ENVIRONMENTAL RESOURCE MANAGEMENT OBJECTIVES & ACTIVITIES

		K-3	4-6	7-9	10-12
CONCEPT A	1. To understand how groups of people historically have managed scarce natural resources for their collective benefit.	The teacher gathers and brings to class natural materials used by California Native Americans.	Students participate in a decision-making simulation game taking place on a wagon train.	Students are presented with situation cards describing a lifestyle from the past and present expectations for the future.	Students describe their attitudes toward natural resources from the viewpoint of persons in the distant past.
	2. To be aware of the key factors in the world today that have contributed to the decreased availability and quality of all natural resources.	Students simulate the effects of population growth.	Students monitor TV commercials and discuss how consumption patterns have changed over time.	Students study maps of an imagined wetland island. They note changes over time, and make recommendations for the development of the island along more environmentally sound lines.	Students research the changes which have occurred in local commute patterns since World War II.
CONCEPT B	1. To be aware of the importance of nonrenewable resources for maintaining our lifestyles.	Students monitor their classroom water use and take action to reduce water use.	Students conduct an energy audit of their classroom and discuss energy waste.	Students take a look at the air pollution problems of Los Angeles and determine ways in which Angelenos might improve the situation.	Students learn to read electric and gas meters. They do an energy audit of their homes.
	2. To be aware of economic, legislative, social, and other means that can be used in promoting the conservation of resources.		Students conduct a survey to assess attitudes and incentives related to recycling.	Students examine the bill which made the 55 miles per hour speed limit the law, its hows and whys.	Students state their opinions on the many "ways" to save a tree and rank them on effectiveness and desirability.
	3. To become aware of the potential for recycling and reclaiming resources.	Students make paper from used paper, cardboard and other materials.	Students choose a household container and research how it was made and what happens when it is "thrown away."	Students put together a picnic lunch with the minimum amount of unrecyclable materials, a "garbage free" lunch.	Students take a fact-finding trip to a local recycling center and interview the persons involved in the recycling effort.
CONCEPT C	1. To be aware of the role of technology in renewing and recycling resources.	Students take a short field trip to a Christmas tree farm or sales lot. Students make decisions about Christmas trees.	Students visit a lumberyard and interview a lumberyard worker.	Students make musical instruments out of forest materials.	Students learn how agriculture alters the biosphere and how much land surface has been altered by human activity.
	2. To understand that through technology, we expand the range of resources which we use in meeting our needs and desires.	Students examine their shoes, consider how shoes are made, and identify the variety of materials used.	Students take a survey of things at school, how these things got there and the fuel used for moving these.	Students learn rudiments of road map reading and discuss transportation in California, past and present.	Students design environmental, energy and resource management games requiring technological solutions.
	3. To be aware of the complexity that often exists in resource management, especially when intergovernmental and intercorporational cooperation is required.	Students plan and manage a classroom garden.	Students are each given control over one major resource. They negotiate with other students to get needed resources.	Students research episodes of California history concerned with resource management, such as The Great San Francisco Egg War.	Students discuss a hypothetical situation showing the trade-offs necessary to, and common in, resource management.
	4. To understand the necessity of long-range planning for resource management in relation to the assessment of future needs.		Students compare their "lifespans" to the "lifespans" of selected resources.	Students design a community emphasizing the relationship between the work place and the residence.	Students organize an expedition walking trip of 200 hundred miles (320 km) or more, using a systems approach to planning and problem solving.
CONCEPT D	See California State Resource Agencies section.				

WAY BACK WHEN

DESCRIPTION
Students describe their attitudes towards natural resources from the viewpoint of persons in the distant past, recent past, present, and future.

OBJECTIVE
A-1. To understand how groups of people historically have managed scarce natural resources for their collective benefit.

PURPOSE
To show that attitudes towards management of resources change with time and are not absolute.

Time	Where
1 hour	Classroom
Topics	**Materials**
Cultural history, environmental values	None

LEAD-UP/PREPARATION
Divide your class into six small groups. Assign a time to each group as follows:

Group 1
Ancient Greece, 500 B.C., when it was believed that the gods and demigods and all sorts of nature spirits inhabited wild places. Every tree had a spirit, and every brook its guardian being.

Group 2
The late Roman Empire, 300 A.D., when the gods were forgotten and the Empire and its works, roads, army, and monumental buildings were the symbols and substance of the people.

Group 3
The early middle ages, 750 A.D., when all was fear and superstition, when learning was almost forgotten and the sword was often used, when few traveled and only a few could read.

Group 4
The High Renaissance, 1550 A.D., when the ideas of the ancients were rediscovered and beauty and art flourished along with trade and the opening of the East and the New World.

Group 5
The Age of Enlightenment, 1700 A.D., when science became the way to the new horizon of prosperity and self-knowledge, the age of Newton, Descartes, and Voltaire.

Group 6
The Industrial Age, 1880 A.D., when new methods and mass markets created the highest standard of living for the greatest numbers of peoples ever, when natural resources were used in ever-increasing quantities for the greatest good for the greatest number.

ACTIVITY

Step 1
Have each group devise an answer to each of the following questions in keeping with the attitudes of the people of the time they represent. Some of the questions have a modern basis and would be absurd if asked of an ancient Greek or of Newton, but have your students answer them anyway.

Q: What is the worst thing your government (king, emperor, etc.) is doing to your town, city, or countryside?
Q: What can you do to change your government's actions toward the environment? What impact can you have on the actions of those in power?
Q: Your neighbor has just cut down an acre of trees to use as firewood. What do you think about that?
Q: The local merchant is selling alligator shoes. Are you going to buy any?
Q: The government has just passed a road tax. How should the monies generated be used?
Q: The king (president, emperor, senate, etc.) has just called for the

raising of an army to fight the bad guys from the East. When are you going to join up?

Step 2
Share the responses made by each group with the class. Have one member from each group explain the attitude of the people of his/her time towards the issues raised by the questions.

Step 3
Answer the six questions in a class discussion. The entire class is now here in the present. What consensus, if any, is reached by the class on the six questions? Did people in the past have as many divergent views as do people nowadays? If not, why not? (Possibly the effect of media bombardment.)

Step 4
Make a chart for study of the responses, through time, to the six questions.

FOLLOW-UP

1. Have the students sketch an outline for a science fiction story based on one of the six questions which will describe hypothetical *future* attitudes towards power, helplessness, resource management, endangered species, mass transit, war, etc.
2. Have the students do in-depth research on the historical period they represented. Some interesting research topics might include:
   - Thirteenth century smog laws in England
   - The great buffalo hunts
   - The Dodo bird
   - The effects of the Hundred Years war on the countryside and population of France
   - Child labor practices in the first half of the nineteenth century
   - The growth of the Venetian glass industry

BAY BRIDGE BLUES

DESCRIPTION

Students research the changes which have occurred in local commuting patterns since World War II. They investigate the growth of their community over the last few decades.

OBJECTIVE

A-2. To be aware of the key factors in the world today that have contributed to the decreased availability and quality of all natural resources.

PURPOSE

To describe the changes which have occurred since World War II in local communities due to increasingly complex changes in technology and population.

Time	Where
3 hours spread over 2 weeks	Classroom
Topics	**Materials**
Transportation, land use planning, cities	Access to phone books from major communities in California, envelopes and stamps

LEAD-UP/PREPARATION

Hold a class discussion on the growth of your community.
Q: How old is the house you are living in?
Q: What was there before your house was built?
Q: What was the street like before your house was built?
Q: Was the large street near your home always as wide as it is now?
Q: How long has the local grocery store been there?

continued

ACTIVITY

Step 1

Prepare a list or have the students prepare a list of the major bridges in California. Such a list would include Los Angeles Harbor Bridge, Benecia Bridge, Humboldt Bay Bridge-Causeway, San Diego Harbor Bridge, Golden Gate Bridge, San Francisco Bay Bridge, San Mateo-Hayward Bridge, Dumbarton Bridge, etc.

Step 2

Divide the class into research teams of two to five students. Assign each a bridge to study. Help the students to find addresses of the administrators for their assigned bridge. Use phone books.

Step 3

Have each group answer the following questions in a report.

Q: When was the bridge built?
Q: What was there before the bridge was built?
Q: What are the physical characteristics of the bridge (length, height, type, type of vehicular traffic—cars, buses, trains)?
Q: What are the peak hours of use?
Q: Where are the users going? How did they get there before the bridge was built?
Q: What is the average length of time it takes to commute over the bridge?
Q: What are the worst traffic problems on the bridge? When do they occur? Is anything done to alleviate rush hour traffic?
Q: What are the bridge director's plans for the future?

Step 4

Discuss the following: The ability of a worker to travel from home to job will often determine the possibility of a person living in a particular area, as well as the possibility of a business locating in a particular area. Many "bedroom" communities depend on the major bridges for their existence. The Golden Gate Bridge made it possible for large numbers of people to live in Marin County and work in San Francisco. Property values in Marin County are very high largely because of the ease with which the residents can get to their jobs in the city and to other attractions the city has to offer.

Q: What are the positive and negative short and long-term effects of the major bridges of California? (Dependence on auto, building of freeways, growth of suburbs, decentralization of population, depopulation of inner cities, etc.)

FOLLOW-UP

1. Take a trip to your local planning commission offices. Ask to see maps of your community from 1945 to now. What are the major differences you see?
2. What is gentrification? (Migration of upper middle class families back into the cities.) Is this a good or a bad trend? What are cities doing to encourage gentrification?

METER MIND

DESCRIPTION

Students learn to read electric and gas meters. They do an energy audit of their homes. This can be extended to gasoline and other commercial energy sources.

OBJECTIVE

3-1. To be aware of the importance of nonrenewable resources for maintaining our lifestyles.

PURPOSE

Energy in all forms is becoming increasingly scarce. The lesson shows that consumption patterns have been and may be further altered in response to the energy crunch.

Time	Where
2 hours in class plus homework 2 weeks home survey	Classroom, home
Topics	**Materials**
Energy resources, technology, economics	For each student: Student Activity Sheet (see below), How to Read Your Kilowatt-Hour Meter Sheet (see below)

LEAD-UP/PREPARATION

Prepare *Student Activity Sheet* and *How to Read Your Kilowatt-Hour Meter Sheet* for distribution to the class.

How to Read Your Kilowatt-Hour Meter. The kilowatt-hour meter is an instrument used to measure electrical energy consumed by a customer. Two types of meters used by the power company are the digital- and dial-type meters. The digital meter is read directly from left to right as shown in Figure 1. Readings on some digital meters are obtained by multiplying by ten.

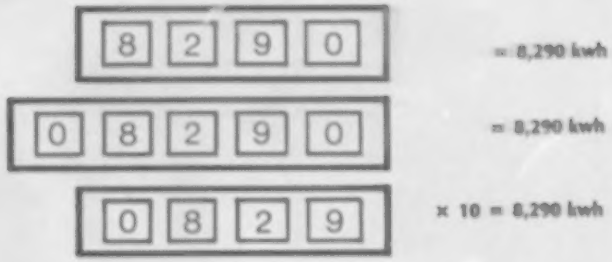

Figure 1—Digital Kilowatt-Hour Meters

Most meters have four or five dials (see Figure 2). On the figure above, each of the dials indicates the number of kilowatt-hours (kwh) registered by the meter during the time that the hand on that dial makes one complete revolution. So, when the hand on the right-hand dial has passed from one figure to the next, 1/10 of 10 kwh, or 1 kwh, has been used.

Be sure to read the meter "backwards"—from right to left—and remember to read the smaller of the two numbers between which the pointer on the dial is standing. *This is very important.*

Note that the pointers of the 10 and 1,000 dials rotate clockwise and counterclockwise on the 100 and 10,000 dials. During the time that the pointer on any one dial is making a complete revolution from 9 to 0, the pointer on the next dial to the left will pass from one figure to the next. Therefore, although a pointer on one dial may appear to have arrived on a given figure, that figure should not be read unless the pointer on the dial to the right has reached or passed 0. For example, in Figure 2, the pointer on the 1,000 dial looks as if it is on the 5, but you should read that dial "4" because the pointer on the 100 dial, to the right, has not made a complete revolution to 0. The correct reading is shown under the dials.

continued

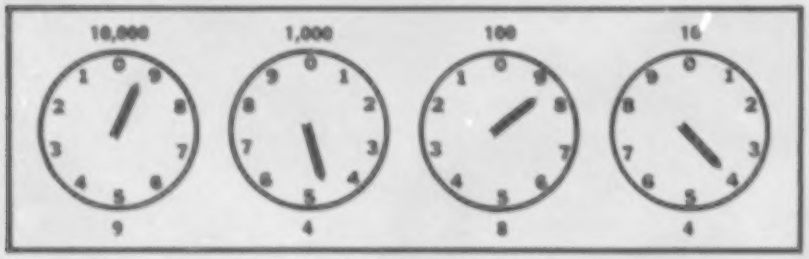

Figure 2—Dial Kilowatt-Hour Meter

ACTIVITY

Step 1
Distribute *How To Read Your Kilowatt-Hour Meter* to the class. Go over the material until the class understands it. Give plenty of examples.

Step 2
Discuss the key concepts.

- A *kilowatt* is a measure of electricity; it is 1000 watts of electricity; it is the amount of electricity used by lighting ten 100 watt bulbs for one hour.
- Conservation efforts have measurable effects on consumption.
- Reduced consumption means savings on utility bills.
- What people do makes a difference. Rate of use of energy resources will determine how long supplies last.

Step 3
Have your class take the *Student Activity Sheet* home for two weeks; be sure students follow the instructions carefully.

Step 4 (Optional)
This energy lesson includes reading gas meters and fuel oil bills and keeping track of gasoline purchases. Students may then be able to total their direct home or school use (per day or per month) of commercially-supplied energy. Some conversions may be necessary in order to make figures comparable: convert to units of Calories per day (Cal/day) as follows:

natural gas: cu. ft./day × 260 calories/cu. ft. = Cal/day
(based on typical content 1,030 BTU/cu. ft.)
fuel oil: gal/day × 34,000 cal/gal = Cal/day
gasoline: gal/day × 32,000 cal/gal = Cal/day
electricity: kwh/day × 860 cal/kwh = Cal/day

Going a step further, recognize that getting energy to the home also costs energy. Mining, refining, and transporting fuels also require energy use. You can approximately account for that cost by multiplying natural gas, fuel oil, and gasoline Cal/day × 1.1 to get a new Cal/day total.

Electricity generated from fossil or nuclear fuels is more fuel-expensive to produce than are primary energy sources. For every three units of fuel burned, only one unit of electricity is realized. The balance is released as waste heat. To approximate the system input for the electric Cal/day, multiply the figure times three.

Step 5
To calculate per-person share of this Caloric total, divide by number of persons in the household (or number of students in the school if school records are used).

FOLLOW-UP

Consider other ways people use energy that do not show up on their home utility bills (manufacturing costs of cars, appliances, food processing, medicines, newspapers; services of doctors, repair persons, police, and military; all construction; transportation systems to distribute manufactured goods and agricultural products; use of laundromats, hospitals, shopping malls, offices, etc.). There is a difficult-to-quantify additional daily sum of energy used per person that raises the U.S. per capita daily average to more than 220,000 Calories/day.

Adapted from *IDEAS*

HOW TO SAVE A TREE

DESCRIPTION
Students state their opinions on the many ways to save a tree and are asked to rank them according to effectiveness and desirability.

OBJECTIVE
B-2. To be aware of economic, legislative, social, and other means that can be used in promoting the conservation of resources.

PURPOSE
To show that there are many ways in which environmental practices can be fostered and that they all involve trade-offs.

Time	Where
1 hour	Classroom
Topics	**Materials**
Forests, environmental values, economics	HOW TO SAVE A TREE for each student (see below)

LEAD-UP/PREPARATION
Discuss. "Trees are renewable resources inasmuch as they can be grown at a reasonable rate to replace those which have been harvested. It seems that people, even though they use forest products every day in ever increasing amounts, have an emotional attachment to trees. They often want to, as the bumper sticker says, save a tree. We're going to look into ways of saving trees and are going to rank them according to their effectiveness and desirability."

ACTIVITY

Step 1
Present the following list of ways to the class.

HOW TO SAVE A TREE

1. *Recycle paper.*
2. *Recycle wood.*
3. *Repair wood products that break.*
4. *Refuse to buy wood.*
5. *Share your newspapers and books with friends.*
6. *Don't use varnish and other wood resin products.*
7. *Actively lobby to cut lumber companies' profits.*
8. *Start a campaign to end defoliant spraying of forests.*
9. *Campaign to close National Forests to logging.*
10. *Create more National Parks.*
11. *Declare the redwood off-limits to logging.*
12. *Chain yourself to a tree.*
13. *Use more plastics and less wood.*
14. *Substitute cotton and other fiber products for wood products (cotton diapers vs. disposable diapers, for example).*
15. *Write threatening letters.*

Rank these according to which are the most effective in saving a tree, and which are the most desirable.

Step 2
Go through each of the ways with the class. Discuss the trade-offs of each of the ways. For example, using more plastic is often unaesthetic and promotes the use of petrochemicals, not necessarily a desirable outcome. Writing threatening letters is illegal in some cases. Recycling paper is good, but perhaps it would put some lumberperson or truck driver out of work (even though the recycling industry is creating jobs). Some of the jobs that spraying does could be done by laborers, but it would take longer and be more expensive. The price of lumber could go up as a result of banning spraying.

continued

Step 3

Also outline the following facts about paper for the class.

1. Over 75 percent of the paper made in the Western U.S. is from sawmill and plywood waste that formerly was burned.
2. Many by-products of paper making are used in consumer products often as substitutes for petrochemicals.
3. Packaging allows for foods to be kept longer and for a greater variety of products to be marked. "Overpackaging" has not really been defined.

Step 4

Have the class again rank the list of ways according to which are the most *desirable*. How have the rankings changed since the first time? What major contentions still remain?

FOLLOW-UP

1. The lumber companies refer to what they do in terms that a farmer might use. They speak of tree farms and crop management and harvesting. How much like farming is the lumber industry?
2. Invite a representative of a lumber company to visit your school. Remember, like many other segments of our society, the forest industry has a point of view and a message they want to get across to the public.
3. Invite a representative from an environmental group, perhaps one that is engaged in curtailing the actions of the forest industries. Remember, like many other segments of our society, an environmental organization has a point of view and a message it wants to get across to the public.

RECYCLING FIELD TRIP

DESCRIPTION

Students take a fact-finding trip to a local recycling center and interview the persons involved in the recycling effort.

OBJECTIVE

B-3. To become aware of the potential for recycling and reclaiming resources.

PURPOSE

To show what resources may be recycled and to promote an understanding of the value of recycling to the environment.

Time	Where
½-day field trip	Local recycling center
Topics	**Materials**
Recycling, environmental ethics	Collected recyclable materials brought from home (cans, bottles, etc.), scale

LEAD-UP/PREPARATION

Transportation: If field trip dollars are not available for a school bus, try your local city bus service or suggest that children take their families to the center as a weekend homework assignment. Or, perhaps parents will take a committee of children to interview and report back to class.

Arrangements: Call ahead for a tour, interviews, and demonstrations of any machinery.

ACTIVITY

Step 1

Have each student bring three days of family recyclable solid waste. Sort and weigh your collection.

Q: How many pounds (km) per family?

Q: How many pounds (km) would a family produce in one year?

Step 2

List each kind of recyclable's source, production, use and disposal alternatives. Discuss how our actions toward packaging and newspapers affect tomorrow's harvest of trees.

Q: How can *you* conserve trees?

Step 3

Take the load of materials with you to the recycling center.

Step 4

A few starter questions for the attendants:

Q: Where does each material go?

Q: Why send soda pop bottles back to the factory rather than toss them into the regular glass bin?

Q: How many tons of _____ do you collect each year?

Q: How does the center make a profit?

Q: What sorts of containers do you recommend using in order to save energy?

Q: How many people use this center?

FOLLOW-UP

1. For more information on solid waste write Californians Against Waste, P. O. Box 289, Sacramento, CA 95802, or contact your local ecology center.
2. Design and distribute "recycle" flyers in your neighborhood. Collect enough aluminum cans to buy a classroom rug.
3. Discussion: Are there any trade-offs necessary when recycling? By reusing items are we cutting down on jobs in certain industries? Are new jobs created by recycling?

Adapted from Manure to Meadow to Milkshake

DOWN ON THE FARM

DESCRIPTION

Students learn how agriculture alters the biosphere and how much of the land surface has been altered by human activity. Farming depends on renewability of resources.

OBJECTIVE

C-1. To be aware of the role of technology in renewing and recycling resources.

PURPOSE

To show that modern agriculture may have disruptive effects on the biosphere.

Time	Where
1½ hours	Classroom
Topics	**Materials**
Farming, land use, preservation	Old magazines, graph paper

LEAD-UP/PREPARATION

Students should be introduced to agricultural processes and have a background in our dependence on the ecosystem. This could be done through assigned reading or by teacher presentation. The class should be familiar with the concepts of biosphere, ecosystem, monoculture, arable land, water table, and marginal soil.

continued

ACTIVITY

Step 1

Have the students look through old magazines, for example, *National Geographic, Pacific Search,* Fish and Game Department publications, *Washington Farmer-Stockman,* etc. The students should find two pictures of landscapes: one which shows a natural, unaltered landscape, and one which shows a landscape altered by human activity—farming, urban, logging, dams, highways, etc.

Step 2

Have the students construct graphs (pie graphs, bar graphs, pictographs, etc.), from the following data:

LAND USE IN THE UNITED STATES:

Total area of 50 states—3,615,122 sq. mi. (about 9,000,000 sq. km)

15.5 percent cultivated
23.9 percent pastureland
7.6 percent wood lots, barnyards, etc., nonfood producing
47.0 percent agricultural
21.0 percent National Forest, excluding parks
13.0 percent public land used for grazing
2.4 percent urban (equivalent in area to Minnesota)
1.1 percent paved roads (equivalent in area to Virginia)
.8 percent wilderness (equivalent in area to West Virginia)
14.7 percent other (suburban, industrial, wildlife refuges, national parks)
100.0 percent

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Step 3

The students can present their pairs of pictures for class examination and discussion.

Q: Is the natural landscape truly devoid of all human artifacts? For example, fences, roads, powerlines, etc.?
Q: In what ways has the altered landscape been changed by human activity? For example, what can be seen that has been added, such as structures, land fill, water (in the case of reservoirs) concrete.
Q: What has been removed, such as vegetation, invertebrate organisms, wildlife?
Q: What unseen changes may have occurred in the altered landscape, depletion of minerals, leaching, lowering of water table, addition of pesticides, etc.?
Q: Discuss what happened in the midwest dust storms of the 1930's.

FOLLOW-UP

Students may wish to debate whether agriculture or other human activities are more disruptive.

Bibliography and Resources

Replenish the Earth, G.T. Miller, Wadsworth Publishing Co., Inc., Belmont, CA. Section 6-5, pp. 113-115, chapter 4, pp. 57-82, Sections 4-6, 4-7, pp. 74-8?

Adapted from *Energy, Food and You*

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EGG DROP SOUP

DESCRIPTION
The students play environmental, energy, and resource management games requiring manipulation of materials. They create technologies to perform certain tasks.

OBJECTIVE
C-2. To understand that through technology, we expand the range of resources which we use in meeting our needs and desires.

PURPOSE
To show that technology can create answers to problems in resource management.

Time	Where
1 hour and ongoing	Classroom and school grounds
Topics	**Materials**
Technology, scientific methods, resource management	Many and varied; student-scrounged items

LEAD-UP/PREPARATION
Technology is often viewed as either the good guy or the bad guy; the solution or the problem. Can you make a list of some of the results of modern technology which are all bad or all good? Mostly bad or mostly good? Share your results and discuss.

ACTIVITY
Following is a list of tasks. They are game descriptions or problems to be solved. They are technological in nature inasmuch as they require a technological approach: assessment of the problem, suggested solutions, trial and error, redesign, etc. Do as many as you think the class would enjoy. They may be assigned to your class as individual, small group, or whole class assignments. They may be set up as competitions or cooperations. They may be used as simulations of corporate, agency, or group processes. (The SEEPCO Corporation has been offered a contract to . . . etc.)

Tasks

1. Design a container which will keep an ice cube from melting completely for three hours while sitting on the teacher's desk.
2. Design a container or method to keep an egg from breaking when dropped from the roof of the school to the pavement below.
3. Design a paper airplane which will stay airborne for 30 seconds.
4. Figure out a way to get the entire class to stand in an area just four feet by four feet (120 cm).
5. Figure out a way to lift a student's chair four feet (120 cm) in the air without anyone touching it. (The gloved hand and similar solutions are not permitted.)
6. Figure out a way to soundproof your classroom.
7. Have students think up more tasks.

FOLLOW-UP
Do any of the technologies you invented have practical applications?

INTER STATE PAPER COMPANY

DESCRIPTION
Students discuss a hypothetical situation showing the trade-offs necessary to, and common in, resource management practice. They make value judgments and are asked to propose alternate solutions to the problem.

OBJECTIVE
C-3. To be aware of the complexity that often exists in resource management, especially when intergovernmental and intercorporational cooperation is required.

PURPOSE
To demonstrate the complexity of resource management and to show the degree of interaction and cooperation necessary in the resolution of such problems.

Time	Where
1 hour	Classroom
Topics	**Materials**
Resource planning, economic development, co-generation, environmental legislation	Each student has a copy of scenario (see below)

LEAD-UP/PREPARATION
Make a copy for each student of the situation below:

ACTIVITY
Step 1
Present this situation to your students:
Some time ago, Inter State Paper Company officials, in order to comply with new air and water pollution regulations, hired pollution-control technicians to study the company's manufacturing operation. The technicians now have presented a pollution-reduction plan to Inter State's board of directors. The new process would reduce odorous gas emissions (air pollution) by 95 percent and the B.O.D. (measure of water pollution) added to the river by 94 percent. The control measures would cost an estimated $11 million but, with some state financial assistance, the company will be able to install the new process within a few years. The new process would have the additional benefit of enabling the company to recover and reuse or sell most of the waste products now dumped into the river and air.

There is one problem. The new process would require substantial amounts of electricity. The power can be obtained from a coal-fired plant that would have to be constructed. This plant also would require pollution-control devices but it would have the advantage of generating enough new electricity to meet the increasing energy needs of the community as well as those of the paper plant. Coal for the plant most likely would come from strip mining but this issue will be decided by pending federal legislation. Inter State has proposed an alternative to the coal-fired plant. The company believes it can supply the additional electricity needed by installing a wood and wood-waste fired boiler in its plant. Drawbacks are that this boiler would cost three times as much as one using only coal or gas and it would not produce any excess power for the community. Inter State would have to raise prices for its products to get the necessary funds and the community's energy needs would not be met.

Step 2
After students have familiarized themselves with the situation, discuss these questions:
Q: What are the advantages and disadvantages of Inter State producing its own energy?
Q: What are the advantages and disadvantages of a new coal-fired power plant?
Q: If the company installs its own boiler and then raises its paper prices, what effect might there be on sales? Would you be willing to pay more for your paper? Would you be willing to use less?
Q: What implications does the choice of a power source have on the future of the company and of the community?
Q: What are the trade-offs involved in this situation?

Q: What options are available to the community?
Q: If you lived in this community, which option would you choose? Why?
Q: How realistic is the situation presented?

FOLLOW-UP
Have each student write a position paper as if s/he were one of the following persons involved in the above situation:
— Inter State's Chief Executive Officer
— Inter State's Chief Engineer
— The local mayor
— The local Environmental Protection Agency representative
— A high school student in the town
— An environmentalist

Adapted from *Environmental Education Activities Manual*

THE LONG WALK

DESCRIPTION
Students organize an "expedition" walking trip to a relatively distant, 200 miles (320 km) or so destination, using a systems approach to planning and problem solving.

OBJECTIVE
C-4. To understand the necessity of long-range planning for resource management in relation to the assessment of future needs.

PURPOSE
To give students experience in logistical planning of a major environmentally-related task.

Time	Where
2 weeks to one semester—ongoing	Classroom Community resource centers
Topics	**Materials**
Scientific methods, resource planning, recreation, survival	Student acquired (many and varied)

LEAD-UP/PREPARATION
Teacher invites class to share hiking and camping experiences. Perhaps invite a local outdoor group to speak and demonstrate materials which they have used in outdoor situations. State agencies, federal agencies, and local governmental and citizens' groups may also be able to provide materials about outdoor resources and locations in your area.

ACTIVITY

Step 1
Teacher presents the premise: "Suppose you were planning to take a long hike this summer with one or two friends to (name an attractive natural area about 200 miles away). What sorts of things would you have to do before going and what sorts of things would you have to

continued

bring with you? What sorts of things would you have to be sure you could acquire on your way?" Brainstorm a list of answers to these questions.

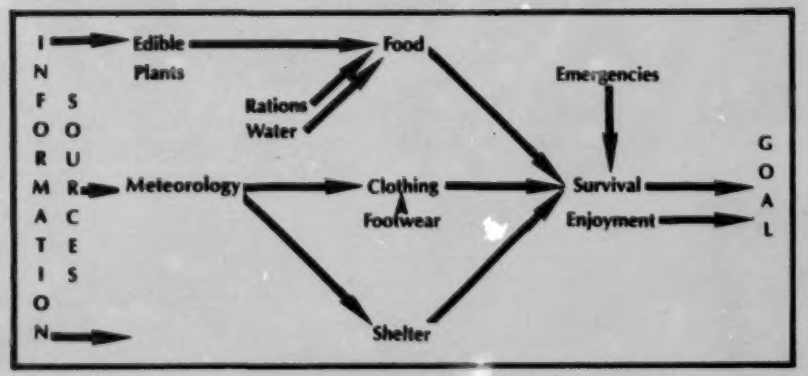
Step 2

Divide the class into small groups. Ask them to brainstorm a list of skills and knowledge they would need to have a safe and enjoyable trip. Some possible answers might include map reading skills, camping skills, first aid and other emergency procedures, knowledge of edible plants and natural biology, survival skills, information on the geography and geology of the region, knowledge of cultural history (Native American, Oriental, Latino, Anglo, and Black regional history), organizational skills such as a knowledge of local laws affecting travelers, meteorology, physical conditioning, fire and shelter building, signalling, etc.

Each of the above skills and subject matters may be referred to as being *modules* of a *system* designed for the *goal* of getting one or more persons to the goal location. Each module is related to the goal. Each module is related to other modules in the system.

Step 3

Create a *Systems Flow Chart*. At the right hand edge of a large roll of butcher paper write the word *goal* in magic marker. At the left edge, write the words *information sources*. At the middle, write the words *food, clothing, and shelter.*



Each of the skills or subject matters listed in Step 2 fits somewhere on this Systems Flow Chart. Complete the chart with arrows drawn between each of the modules to show their relationships to each other. (See partially completed example below.) Define the entire piece of paper as the *system* and each of its parts as *modules*. The arrows are called *vectors*.

Step 4

Allow each student to pick a module for investigation. Be sure each module is covered. More than one student may work on a particular module.

Step 5

Allow the students to choose a leader for the expedition to whom they will report the results of their research. S/he may be the person for whom they are designing their responses; what are his/her tastes in food, shoe size, etc.? The leader, with the help of the class, should evaluate the information as it comes in on an ongoing basis. The research will lead to further areas of study.

The main role of the teacher in Steps 4 and 5 is to direct students to resources. The teacher, with the help of other members of the faculty (the science teacher, history teacher, librarian, etc.), should be able to direct students to an appropriate resource to find, for example, what weather might be expected in mid-July along the route, or where safe sources of water are.

Step 6

Discuss:

Q: Do we now have enough information to make a walk to _____ safely? Will the trip be fun? Now that we are so very well prepared, has some of the edge, the mystery, been taken away?

FOLLOW-UP

1. Can you think of some environmental problems to which we can apply a systems approach? Is this a good way to approach large tasks?
2. Apply the systems approach to solving a local environmental problem.
3. Take the long walk.

APPENDIX

SOURCES OF CLASSROOM ACTIVITIES

- **CAPTAIN HYDRO**
  Produced by
  East Bay Municipal Utility District
  P.O. Box 24055
  Oakland, CA

  Distributed by
  Office of Water Conservation
  Department of Water Resources
  P.O. Box 388
  Sacramento, CA 95802

  Captain Hydro is an upper-elementary workbook promoting water conservation. The student activities draw from many subject areas. East Bay Municipal Utility District has prepared Captain Hydro and other K-12 curriculum materials as part of Project Water.

- **CLASS PROJECT**
  National Wildlife Federation
  1414 Sixteenth Street, N.W.
  Washington, DC 20036

  CLASS Project is Conservation Learning Activities for Science and Social Studies. These activities focus on environmental issues such as land use planning, solid waste management, and hazardous wastes. They are aimed at the junior high student.

- **ENERGY, FOOD AND YOU**
  Washington State Office of Public Instruction
  Office of Environmental Education

  Energy, Food and You is an interdisciplinary curriculum for secondary schools. It presents issues related to global food production and food-producing resources.

- **ENERGY LEARNING CENTER**
  Chevron USA, Inc.
  595 Market Street
  San Francisco, CA 94105

  The **Energy Learning Center** is a teaching unit aimed at introducing basic energy information and energy issues to students in grades 6-8. It is a

packet of 18 "fact sheets," a time line, a poster, a teacher's guide, and activity duplicating masters.

- **ENERGY AND MY ENVIRONMENT**
  Governor's Energy Office
  Tallahasee, FL 32301

  Energy and My Environment is a K-12 energy education curriculum in three teachers' guides (K-6, 7-9, 10-12). The activities are organized around seven conceptual schemes.

- **ENVIRONMENTAL EDUCATION ACTIVITIES MANUAL**
  Edited by William Stapp and Dorothy Cox (1974)
  30808 LaMar
  Farmington Hills, MI 49024

  This six-volume activities manual is designed to provide K-12 experiences that promote basic environmental education concepts. Each volume has activiites to (1) develop sensitivity toward the environment, and (2) recognize problems, develop problem-solving skills, and take action to solve environmental problems.

- **GREEN BOX**
  Environmental Education Program
  Humboldt County Office of Education
  901 Myrtle Avenue
  Eureka, CA 95501

  Greenbox is a kit containing student activity cards, teacher booklets, program philosophy, and rationale. It is an individualized program for grades K-8; each card gives three activities (K-3, 3-6, 6-8) for the same concept.

- **IOWA DEVELOPED ENERGY ACTIVITY SAMPLER (IDEAS)**
  Iowa Department of Public Instruction
  Grimes State Office Buding
  Des Moines, IA 50319

  IDEAS consists of six secondary (grades 7-12) curriculum guides (home economics, industrial arts, language arts, mathematics, science, and social sciences). The curriculum is multidisciplinary and centers on incorporating energy topics into these six curriculum areas. IDEAS is sponsored by the Iowa Energy Policy Council in cooperation with the Iowa Department of Public Instruction.

- **LAW IN AMERICAN SOCIETY**
  Journal of the National Center for Law-Focused Education
  Law In American Society Foundation
  33 North LaSalle Street, Suite 1700
  Chicago, IL 60602

  This journal is published four times a year. The February 1977 issue presents a series of articles about environmental issues.

- **LET'S RECYCLE!**
  U.S. Environmental Protection Agency
  Office of Water and Waste Managment
  Washington, DC 20460

  Let's Recycle is a booklet of lesson plans for grades K-12. These activities explore topics related to waste disposal. Each short activity description cites vocabulary and questions for discussion.

- **MANURE TO MEADOW TO MILKSHAKE**
  Hidden Villa, Inc.
  26870 Moody Road
  Los Altos, CA 94022

  Manure to Meadow to Milkshake is an experiential approach to helping students understand the interdependencies between their lives and the natural world. Although it is written by and for the Hidden Villa Environmental Project, it is full of easily adaptable activities, songs, plays, etc.

- **MARINE STUDIES IDEA BOOK**
  The Sea Grant Program
  University of Southern California
  Los Angeles, CA 90007

  The Marine Studies Idea Book is for grades K-6. It follows four central themes that cover the history, mythology, ecology, and politics of the sea.

- **OUTDOOR BIOLOGY INSTRUCTIONAL STRATEGIES (OBIS)**
  Lawrence Hall of Science
  University of California
  Berkeley, CA 94720

  Published by
  Delta Education
  Box M
  Nashua, NH 03061

  OBIS is written to introduce youngsters to basic ecological concepts through highly motivating activities. These activities are aimed at youngsters from 10-15 years of age, and are primarily oriented toward community-sponsored youth organizations and nature centers.

- **PERSONAL VALUES AND ENVIRONMENTAL ISSUES**
  by Donald Scherer
  Hart Publishing Company, Inc.
  New York, NY 10003

  This book describes activities that help clarify values related to environmental issues. It covers issues of pollution, energy, food, population, and land use. Groups are to examine these issues as they are guided through the process for making responsible decisions.

- **PIONEERS**
  Interact Co.
  Box 262
  Lakeside, CA 92040

  Pioneers is a simulation activity that involves students in making decisions on a wagon train. Students work together around problems encountered on their journey westward.

- **PROJECT LEARNING TREE (PLT)**
  American Forest Institute
  1619 Massachusetts Avenue, N.W.
  Washington, DC 20036

  Cosponsored nationally by the Western Regional Environmental Education Council, **Project Learning Tree** is a supplementary program designed to complement existing curricula. PLT includes two activity guides: one for grades K-6 and the other for grades 7-12 made available through workshops. For information on workshops and local facilitators, contact Project Learning Tree, c/o Salina Star Route, Boulder, Colorado 80302.

- **PROJECT WILD**
  Salina Star Route
  Boulder, CO 80302

  Project Wild is in its early formative stages, intended to be published in 1985. It will be a supplementary program designed to promote an understanding of wildlife. Project Wild is cosponsored by the Western Association of Fish and Wildlife Agencies and the Western Regional Environmental Education Council.

- **SCIENCE 5/13**
  Macdonald Raintree, Inc.
  205 West Highland Avenue
  Milwaukee, WI 53203

  The **Science 5/13** books are for teachers to help children from 5-13 years learn science through investigative techniques. The lesson objectives link closely to Piagetian stages of conceptual development.

- **SCORING THE LOS ANGELES LANDSCAPE**
  UCLA Urban Environmental Education Project
  University of California
  Los Angeles, CA 90024

  Scoring the Los Angeles Landscape is designed to help learners become attuned to urban ecology. Activities cover components of urban systems, such as air, energy, transportation, population, etc. These activities are appropriate for use by teachers of secondary students.

- **SHARING NATURE WITH CHILDREN**
  by Joseph Bharat Cornell
  Anada Publications
  900 Alleghany Star Route
  Nevada City, CA 95959

Sharing Nature with Children is a collection of nature-awareness games for anyone who spends time with children. The games are simple ways to help children know nature's ways. Some are purely sensory experiences, some explore ecological principles, and some are just for fun.

- **SHAVER'S CREEK ENVIRONMENTAL CENTER**
  Parks and Recreation Department
  The Pennsylvania State University
  University Park, PA 16802

  Shaver's Creek Environmental Center operates a nature center and a resident outdoor school program—both serve as a laboratory setting for PSU students. The resident outdoor program staff designed and field-tested appropriate technology curricula for grades 4-12.

- **SPACESHIP SCHOOL**
  Marin County Office of Education
  1111 Las Galinas Avenue
  San Rafael, CA 94903

  Spaceship School activities are designed for direct use by kids. Subjects covered are energy, air, water, food, transportation, environmental inventories, and environmental monitoring. There are two sets of Spaceship School activity cards, grades K-3 and grades 4-6. The trial edition was developed by the Marin Museum of Natural Science in 1978.

- **SUNSHIP EARTH**
  by Steve Van Metre — P.O. Box 288
  Acclimitization Experiences Institute — Warrenville, IL 60555

  Sunship Earth is an environmental education program for upper elementary students. It is designed for a residential setting and stresses understandings and feelings related to the natural environment.

- **THE NEW GAMES BOOK**
  The New Games Foundation
  P.O. Box 7901
  San Francisco, CA 94120

  The New Games Book is a starting place for those committed to the world of play. It exudes playfulness through creative, open-ended games. The only fast rule of New Games is "play hard, play fair, nobody hurt."

- **USE THIS**
  The Western Regional Environmental Education Council
  c/o Montana State Department of Education
  Helena, MT 59601

  Use This is a product of a joint effort between educators and resource managers. It describes techniques for examining curriculum materials available from resource agencies.

- **USING WILD EDIBLE PLANTS WITH CHILDREN**
  by Carolie Sly and Molly Whiteley — University of California
  School of Education (PDARC) — Berkeley, CA 94720

  Using Wild Edible Plants With Children introduces children to plant uses through hands-on activities. This packet consists of ten cards covering plants common to California.

- **VALUES ACTIVITIES IN ENVIRONMENTAL EDUCATION (ERIC)**
  The Ohio State University College of Education
  1200 Chambers Road, 3rd Floor
  Columbus, OH 43212

  Values Activities in Environmental Education presents activities for clarifying values related to environmental issues. The activities are for grades K-12 and are suggested for science, social studies, and language arts classes.

- **WET AND WILD**
  Marine Education Program
  USC Institute for Marine and Coastal Studies
  University Park
  Los Angeles, CA 90007

  Wet and Wild, a supplementary teacher's guide, is bilingual (English-Spanish), multidisciplinary, and contains ideas for classroom activities, background information, lesson plans, and references. It covers the physical ocean, ocean management, research, biological ocean, ecological ocean, and economic sea. The Marine Education Program also produces the Marine Idea Books for grades K-6 and 7-12.

California State Resource Agencies

California Coastal Commission
631 Howard Street
San Francisco, CA 94105

The Resource

The Coastal Commission, which includes one state commission and six regional commissions, was established by passage of a citizen initiative, Proposition 20, in the election of November 1972. The Coastal Commission was directed to do the following:

- Prepare a comprehensive, coordinated, enforceable plan for the orderly, long-range conservation and management of the natural resources of the coastal zone.
- During the planning period, to regulate development in coastal waters within a 1000-yard shoreline permit area to ensure that improper development would not undercut the plan being prepared.

The essence of the Coastal Plan is that the 1100 miles of California coastline should be treated not as ordinary real estate but as a unique place where conservation and special kinds of development should have priority. The plan is designed to achieve long-term protection and productivity of coastal resources in times of scarcity, as well as in times of abundance.

The Coastal Plan was completed and published in December 1975. Since then, the state and regional commissions have been overseeing the implementation of the Coastal Act of 1976 which grew out of the plan. Under this act, 67 coastal cities, counties, and four major commercial ports are required to develop local coastal programs which include land use plans and zoning ordinances. Once the Coastal Commission has reviewed and approved the plans, local governments will issue their own development grants. When all coastal communities have had their plans accepted, the Coastal Commission will be dissolved. Theoretically, all of these plans should have been completed by July 1981. However, at the time of publication of this Guide, it is anticipated that only one-half of the plans had been developed.

Long-Term Planning Needs

The Coastal Plan includes ten major categories with recommendations under each. These are described briefly as the long-range planning needs developed by the Commission.

Coastal Water

Improve the productivity of the marine environment through control of overharvesting of marine life through stricter controls on dumping wastes into the offshore waters and through controlling the diking, filling, and dredging of coastal wetlands.

Coastal Land

Protect coastal streams and plan carefully for coastal watersheds by including provisions in local planning for protecting the quality of water feeding coastal wetlands, controlling sand supply and protecting spawning streams.

Retain natural habitat areas through acquisition, recreational controls and the regulation of adjacent development. Many plants, animals, birds, and marine creatures depend on the unique habitat provided by the coast and cannot survive elsewhere.

Encourage coastal agriculture through the alleviation of high property taxes and urban utility assessments, as well as through regulation of zoning and direct economic and technological assistance. The presence of the sea moderates the coastal climate, helping to extend the growing season and protect crops from frost damage. The rich alluvial soils in coastal valleys, combined with the temperate climatic conditions, create some of the finest

and most productive agricultural land in the nation.

Encourage sustained yields in timber production by amending laws to tax timber only as it is cut, rather than taxing the value of all standing trees. Conserve soil and mineral resources by requiring that local building and grading ordinances include effective measures to prevent erosion. Sand and gravel extraction would be barred in environmentally sensitive or highly scenic areas, and site restoration would be required where mining is permitted.

Protect coastal air quality by requiring the cumulative impact of development on coastal air quality to be considered in land use and transportation plans. Major pollution-generating developments, such as refineries, fossil fuel power plants, and freeways, would be excluded from portions of the coastal zone now designated as problem areas for the maintenance of air quality unless there were no more environmentally sound alternatives.

Coastal Appearance and Design

Protect the scenic beauty of the coast by providing guidelines for visually unobtrusive new developments that are subordinate to the setting and use materials that blend with the environment.

Coastal Development

Encourage orderly, balanced development by requiring that new developments be concentrated in areas where the environment can support them with adequate water supplies, sewer services, and adequate road and public transportation capacity. Already developed areas would be favored for new developments. In rural areas not containing significant natural resources, scenic value, or viable agriculture lands, first preference would be given to the development of low profile facilities to serve coastal visitors. Residential development would be restricted to places where other types of development were not feasible. Hazardous industrial activities, such as liquefied natural gas processing, would be limited to areas where several facilities would be concentrated.

Energy

The plan recommends that the Energy Commission have authority over the siting of new power plants and all other major energy facilities including those for petroleum and for power plants. Power plant sites would have to be justified on the basis of no alternative sites, real need, minimal adverse visual impact, and, where feasible, provision of public coastal areas.

Offshore petroleum development would be permitted only if it is part of a national or western regional developmental plan. The plan also recommends revising current federal leasing practices to provide for withholding approval of offshore petroleum development until the exploration has determined the extent of the fossil fuel available and the environmental impacts from extracting it.

Tanker terminal construction would need to be justified on the basis of need beyond the existing facilities. Oil companies would be encouraged to trade oil supplies in order to reduce the need for new facilities and petroleum transport. Existing harbor areas should be used to accommodate Alaskan oil tankers with drafts of about 65 feet, and all other tankers should be restricted to deepwater terminals away from environmentally sensitive areas. Any new facilities would be developed for multi-company use.

Liquefied natural gas terminals would be restricted to a single operation until the public safety risks inherent in these operations are determined. If new terminals are built, they should be concentrated in already existing port areas.

Transportation

Limit adverse environmental effects of coastal access roads by improving the efficiency of already existing roads, promoting use of public transit, and paying special attention to weekend congestion problems. Coastal roads should include scenic parking areas, rest areas, beach access, and picnic grounds.

Provide for water and air transportation facilities within already existing port areas and avoid filling in wetland areas for this purpose.

Public Access to the Coast

Increase coastal recreation while protecting coastal resources through the location of parking areas that are away from the beach areas but with access. Where coastal communities are unduly burdened with providing visitor facilities, the plan recommends the use of state funds. Of course, all recreational areas would have to accommodate to the environmental capacity of the area to support tourism. Acquisition of additional recreation sites and encouragement of private developments to serve visitors is

recommended to meet the rising demand for use of the coastal zone as a vacation and recreation area.

Encourage recreational boating but protect wetlands by requiring that new or expanded marinas be built in natural harbors, in deep water that is not marsh or wetlands, and in areas dredged from dry land. Dry storage, rental programs, multiple ownership, and other means are also proposed to provide for more boating while protecting the wetlands.

Scientific and Educational Resources

Protect sites of scientific, historic, or educational value through an intensified effort to identify and provide protection for the coast's historic and archeological resources.

Restoration

Restore degraded coastal areas with a program that would reduce the numbers of undeveloped coastal lots through purchases and consolidation of lots under common ownership. Purchases are recommended to protect areas useable by the public and in areas where costs of extending urban services would exceed the costs of buying lots.

California Conservation Corps
1530 Capitol Avenue
Sacramento, CA 95814

The Resource

The California Conservation Corps employs 1800 youth between the ages of 18 and 23 on a one-year basis, at minimal wage standards, to work in resource management projects throughout the state. After an initial 20-day training period, the corps members are assigned to one of the 25 CCC centers across the state. At these local sites they may work on resource management projects operated under the auspices of any of the departments within The Resources Agency. The corps is also used in conjunction with local, city, and federal projects. Sample projects include forestry clearance, tree plantings, developing urban parks, and fighting forest and chaparral fires.

The California Conservation Corps is always looking for new members since the work term is limited to one year. Anyone between 18 and 22 who is interested may apply through any local Employment Development Department operated by the state government.

California Energy Commission
1111 Howe Avenue
Sacramento, CA 95825

The Resource

In the early 1970s, California faced the challenge of runaway growth in the projected demand for electrical energy. Large numbers of new power plants were being proposed for construction to meet that rapidly escalating demand. By October 1980, however, California utilities had cut their estimates of the levels of demand in the early 1990s by more than half. In that same month, Southern California Edison Company, California's second largest electric utility, announced a new corporate policy of substantial commitment to conservation and renewable energy resources to meet its electric power needs. These developments and similar actions by the Pacific Gas and Electric Company signaled the end of the energy challenge of the early 1970s.

The formation of the California Energy Commission in 1975 was a major step in the state's response to unchecked growth in electrical energy demand. Since then, the Commission has been a national leader in adopting cost-effective energy conservation standards for new buildings and appliances. The Commission has also been a strong promoter of solar and other alternative energy resources. During this period, the California Public Utilities Commission and the state's electric utilities have redirected many of their efforts into conservation and alternative energy resource development.

Energy conservation provides an increase in the real supplies of an energy source. It represents more efficient use of existing supplies and a reduction in the environmental impact that always accompanies the expenditure of an energy source. In fact, energy conservation is equivalent to an increase in the amount of human well-being that can be extracted from the energy supply.

The notion of a decreased impact on the environment is critical. One of the fundamental misconceptions about the relationship between economic growth and energy consumption is that they are parallel and inseparable.

Successful conservation in a number of ways has shown that this relationship is not fixed and economic expansion is possible without increased expenditures for energy supplies and greater negative impacts on the environment.

Long-Term Planning Needs

There are essentially four approaches to energy conservation that have both short-term and long-range effects for our lifestyles.

Through improved technology and/or operating procedures, we can increase the efficiency with which we use the same amount of energy without any decrease in services. For example, many buildings use excessive amounts of energy for heating and cooling because of inadequate insulation. Similarly, different brands of the same appliance can use energy more or less efficiently. The use of smaller automobiles with less weight and improved mileage per gallon is another source of increased energy payoff. Reduced lighting and heating when commercial buildings are unoccupied can also bring about considerable savings in energy expenditures. In each of these examples, the energy savings are achieved with little or no decrease in the service supplied to the consumer, although, as in the case of smaller automobiles, the environmental impact can be reduced significantly.

Different modes can be used for heating and cooling, transportation, packaging products, and increasing the durability of products that extend the efficiency of the energy source.

Freight transportation is an important example of this type of conservation. Although railroads are much more energy efficient for the movement of freight, there has been a steady increase in the use of trucks for this service during the past two decades. Public transportation systems, deteriorating or practically non-existent in many communities, are vastly more energy efficient than the use of private automobiles. Increased durability of such products as the automobile and appliances can also contribute considerably to the long-range reduction of energy consumption. More efficient heating and cooling systems that require less expenditures of energy for the same effects are another source of energy savings. For example, electric heating is very inefficient from the standpoint of energy consumption. Similarly, solar energy used for heating water in residential buildings is much more energy efficient than the use of petroleum. The quantities of heat generated by petroleum are excessive for the amount of energy needed to heat water.

In another dimension, the energy required to manufacture throw-away glass bottles or plastic containers could be reduced through the more energy efficient use of returnable bottles.

The mix of goods and services within the economy can be changed to increase the contributions to income and employment per unit of energy used with some adaptations of our lifestyles.

For example, more sophisticated communication techniques can be substituted for business travel. Less pleasure travel can also be compensated for by a change of emphasis in leisure activities. Other types of motorized recreation such as trail bikes and motorboats can replaced by less energy-consuming activities such as hiking and sailing.

Changes in energy consumption patterns can be brought about through changes which impose restrictions on energy use that directly affect our lifestyles.

The clearest example of this type of energy conservation is the rationing of gasoline. Smaller residences that require less heating and cooling is another example. Car pools, reduced speed limits, and higher taxes on larger automobiles are other examples of how this more drastic form of energy conservation can affect our lifestyles.

The California Energy System of Today

Oil supplies most of the energy consumed in California.

- California uses 1.9 million barrels of oil per day, about 61 percent of the state's total energy use.
- Imports, principally from Indonesia, total 450,000 barrels per day.
- In-state production is the state's largest supply source.
- Transportation sector uses 62 percent of petroleum products.
- Federal price controls are being phased out in 1981.
- World oil prices increased 2000 percent in the last ten years.

Natural gas is California's second largest energy source.

- The southwestern United States supplies over half of the state's needs.
- About 73 percent of home energy used is natural gas.
- Some gas prices will be deregulated by January 1985.
- Only P5 (power plant) users have experienced major curtailment in recent years.

Electricity supplies only ten percent of California's needs.

- Due to normal generation losses, it uses about 25 percent of our fuels.
- Demand growth rates are decreasing.
- Half of California's power capacity depends on oil and gas as fuel. Power plants used 100 million barrels of oil in 1979.
- Electric rates are rising steeply due to high oil and gas prices and capital costs.
- Electric utilities are closely regulated at the federal, state, and local level.

Conservation is a growth area in the California energy system.

- California is a national leader.
- CEC building and appliance standards reduce energy use.
- Individual business initiatives produce most of the conservation in the commercial and industrial sectors.
- Utility load management reduces peak demand for electricity.
- The state is active in developing regional and intercity rail and bus transportation.
- Federal new vehicle efficiency standards have significant effects on Californians.

California leads nation in use of solar energy.

- The major current applications are solar heating of water and swimming pools, passive solar building design.
- The major government action is the 55 percent state tax credit used for 70,000 installations since 1976.
- The solar industry was a $150 million business in California in 1980.

California Energy Extension Service
1600 Ninth Street, Suite 330
Sacramento, CA 95814

California Energy Extension Service

The Resource

When Congress passed the National Energy Extension Service Act in 1977 to set up pilot programs in ten states, they recognized that a neighbor-to-neighbor approach to conservation information might be the "something different" that was urgently needed to convince Americans to change their attitudes, behaviors, and actions towards energy conservation. After all, if your neighbors are talking about conservation and doing something about it, then it's time for everyone on the block to join the conservation effort.

This personal delivery of conservation information is what makes the Energy Extension Service (EES) different from other programs that the U.S. Department of Energy supports. Through the program, Congress expects to gain a better understanding of the barriers to the adoption of energy-saving measures by small consumers and hopes to reduce the impact of fuel shortages and price increases on small consumers.

The California Energy Extension Service is a $1 million federally funded energy conservation action program of the Governor's Office of Appropriate Technology. EES contracts with established local organizations in communities across the state to provide effective energy management services for users of small amounts of energy who have not been adequately served by other federal, state, and utility programs.

Major Coordination Role

EES is charged with mobilizing the resources of people and their ideas, providing technical assistance, filling gaps, providing links between programs and people concerned with energy management, and promoting the use of energy-conserving practices by those programs not traditionally concerned with energy in California. This has led to a number of programs being jointly developed with other agencies.

Management Philosophy

EES is not a passive education or information program, but one engaged in active outreach with personalized, targeted delivery of energy information involving one-to-one contact with people.

Contracts are the mode of funding, not grants, to assure accountability and appropriate use of public tax dollars. Contractors must submit monthly reports and are closely monitored on a business-like basis to assure effective program operation. Evaluation is an extremely important part of each EES program and is used as a management tool by both the contractors and EES staff. Where problems and barriers emerge, programs can be fine-tuned and adjusted accordingly. Contractors are also brought together periodically for verbal debriefing and peer evaluation which has also proven to be an effective learning process and transfer of knowledge in itself.

The demonstrations EES funds focus on developing programs that are transferable to other groups in other locales so that groups interested in operating similar programs don't have to reinvent the wheel.

Energy Education Program

The Energy Education Program is designed for students, teachers, administrative staff and maintenance personnel, all of whom have a role in and responsibility for energy management within a school. This program will develop models for how these individuals' activities can be coordinated to save energy in schools and educate students about energy. To accomplish this objective, a four part program will be implemented: model demonstration contracts with local schools, teacher training sessions, a clearinghouse/resource center, and an evaluation of existing materials and delivery of services. This program is funded by monies from the Environmental License Plate Fund and operated in cooperation with the Department of Education.

Solar Installer Training

EES manages the SolarWork Institute, funded by the Employment Development Department. The Institute provides instructional materials and resource assistance to solar installer training programs operated by community colleges, union apprenticeship programs, and community-based organizations. The Solar Installer's Training Program Manual is being purchased and used widely by training providers, solar businesses, and the general public. Four training programs have been established with Institute assistance

Energy Management Contracts

In 1980, its first year, EES funded programs addressing six types of energy users. Major contracts developed demonstration programs in gasoline conservation, agriculture, and local government. The EES **Community Energy Program** negotiated 20 contracts of up to $40,000 focused on small business, tenants and apartment owners, and underserved populations. All of these focus areas will be continued in 1981, with the addition of energy cooperatives. Major focus areas include:

- **Renters and Apartment Owners**
  Nearly 45 percent of all Californians live in 4 million units of rental housing and many small businesses rent their stores and office space. It is an area of potentially large savings, yet existing federal, state, and utility programs have generally not provided cogent incentives for energy management investment in the rental sector. EES programs vary depending upon the conditions which affect the relationship between the landlord and tenant who is responsible for utility bills.

- **Underserved Populations**
  Certain client audiences are particularly vulnerable to the rising cost of energy. This category develops informational resources and provides assistance for those to whom information is often denied for a variety of reasons. Most of the clients served by these programs are low income, living in substandard housing in need of repair, unable to decipher documents, and perhaps senior citizens or rural residents. The resources and skills often exist within these "communities" to provide their own services, although they are often under utilized.

- **Small Business**
  More than 400,000 small businesses exist in California, each with its own set of problems. For many business people, energy management is not perceived as a critical or high priority issue. Energy costs have been seen as fixed costs, or ones to just pass on to the consumer. Front end costs are perceived as too high, payback is seen as too long, even if the return on investment is 200 percent, and the terms conservation and audits have negative connotations. In addition, the audience is diverse; commercial, retail, and small industrial. Many small business people rent or lease their business space.

  EES Model Energy Surveys in Santa Cruz showed restaurant managers, car dealers, and grocery store owners how to save 30-40 percent in

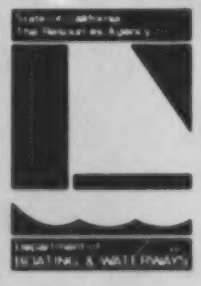
water heating, 25 percent in heating/cooling and ventilation, and 30 percent in delivery costs.

- **Energy Cooperatives**
  Nearly 500,000 Californians are served by consumer cooperatives, many of these being food co-ops. In 1981, EES will be working with the National Consumer Cooperative Bank (NCCB) to create models of sustainable energy cooperatives. Energy co-ops enable consumers to pool their resources in an attempt to deal with the rising cost of energy. Co-ops can be formed to deal strictly with energy-related services and hardware, or these functions can be incorporated into the services provided by housing and food cooperatives. The EES is developing models for all three of these approaches and is investigating the possibility of energy producer co-ops, that is, nonprofit businesses that are owned and managed by the people who deliver these services. The EES money is to be used for technical and informational assistance and the staff and materials required to deliver these services. It is being supplemented by loans that will be paid back to the NCCB for hardware, inventory, etc.

Long-Range Planning Needs

- There is a need to build the capacity to sustain energy management programs and activities in local communities using local resources to meet national needs.
- There is a need to expand the marketing of targeted energy management information to reach tenants, apartment owners, homeowners, small businesses, women minority and ethnic populations, farmers, low income people, youth, and seniors.
- There is a need for better consumer information about:
  - energy conserving devices
  - energy management services, including contractors, energy auditors, shared-energy-savings firms, consultants.
- Energy education needs to be infused through the curriculum with energy action programs at every school.
- Local funding of energy conservation and management programs through innovative financing mechanisms need to be explored.

- Courses should be developed to update contractors and other professionals about energy-saving and alternative energy techniques in new and retrofit constructions for all sectors.
- Women and minorities need to be made aware of and encouraged to select careers in energy management and renewable resources. This extends from well-paying blue collar positions to those at the professional and managerial level.
- Energy management concerns need to be integrated into the comprehensive planning of each city and county.
- Attractive financing mechanisms for consumers and small businesses need to be further developed and expanded.



Department of Boating and Waterways
1629 S Street
Sacramento, CA 95814

The Resource

The Department of Boating and Waterways is the agency that provides service to the boating community in California. The authority to operate and provide services comes from the State Resources Code and the Harbors and Navigation Code. The 1,100 miles of coastal waters, over 1,000 lakes and reservoirs, and thousands of miles of rivers are navigated by an estimated 2.5 million recreational boaters annually. Countless others use this resource for a variety of other activities.

The services provided by the Department of Boating and Waterways include development of boating facilities, beach erosion control,

environmental review, waterway planning, safety and education, enforcement, and yacht and ship broker licensing.

Long-Term Planning Needs

Develop and Preserve Public Boating Access

Recreational boaters and other aquatic participants require public access to the waters of the state. As land adjacent to the state's waters is developed by private interests and public access is limited, the need for the acquisition and preservation of public boating access becomes more important. The California Constitution, Article X, Section 4 states that without regard to the mode of aquatic use for any public purpose, the right of free and unabridged use of the state's navigable waters shall be maintained.

To assist the recreational boater in the use of public waters, the Department of Boating and Waterways develops public launch ramps, marinas, and other forms of access. These facilities are created to provide maximum enjoyment for the public with the least possible impact to the environment.

Conflicts Related to Access

The development of public access brings with it some concerns for environmental issues.

Conflicts that occur near the state's waters often include illegal trespass, litter, sanitation, and other similar problems. The acquisition of land adjacent to public waters can often reduce local conflicts. Where large-scale development means endangering riparian or wetland ecosystems, special efforts are made to minimize impact, or in come cases, enhance such areas.

Boating Safety

One of the most important functions of the Department of Boating and Waterways is promoting boating safety for the prevention of accidents, loss of life, and property damage. Assistance is provided to all statewide public boating safety courses offered by other agencies, such as Red Cross, U.S. Power Squadrons, U.S. Coast Guard Auxiliary, Scouts, YMCA's/YWCA's.

Educational services are provided to all public schools at a variety of grade levels. Films, coloring books, posters, and safety pamphlets are available without cost. Additionally, a complete high school boating safety course is offered. This course can be used as a separate offering, or as an element of another course. The materials for this course include textbooks, instructor guide, films, examinations, and handouts.

Department of Conservation
1416 Ninth Street
Sacramento, CA 95814

The Resource

As California's population grows, government planning at all levels for the use of land, now and into the future, is critical. Land use planning includes the recognition of geologic hazards (such as faults, landslides, coastal erosion) and other fundamental geologic knowledge (such as the location of mineral resources) which is related to safety and economic well-being of the citizens of California. To make these decisions wisely, planners need to tap different sources of information. Many of those sources are within the Resources Agency and several departments feed information into this process from the different perspectives of their expertise.

The Department of Conservation monitors the conversion of agricultural lands and administers the Williamson Act, a program that protects agricultural land that is in danger of being urbanized. In addition, the Department has an ongoing interest in the preservation and better use of soil resources. Data developed from these programs are made available to resource and land use planners to provide them with up-to-date information on which to base their planning.

The Division of Mines and Geology in the Department of Conservation has responsibility for collecting information about the surface and undersurface area of our landscape, including the location of earthquake faults and valuable mineral resources. Information about the location of mineral deposits is essential to the total picture that is needed in land use planning. Valuable mineral resources could be covered over by development and lost for use. Areas that are mined can be reclaimed for community use.

Two types of geological information are collected and disseminated by the Department of Conservation in the service of land use planning. One type focuses on a broad, general picture of the geologic structure and location of mineral resources throughout the state. Information of this type includes chartings of major earthquake faults. The data can

be used to map out broad geographic areas where it would be safe to situate critical installations, such as dams and power plants.

The other type of geologic information focuses on specific sites. Studies are undertaken to identify land movements within a small area in the case of making decisions for siting a dam and reservoir. Earth shifts are studied over periods of time and estimates are made about the feasibility of a structure withstanding the impact of any earth movements. Many studies on the subject of earthquake faults are conducted in conjunction with local communities throughout the state for this purpose. Other studies are conducted in cooperation with federal agencies as part of broad land use planning at the national level.

One avenue for dissemination of the information collected by the department is through advisory services to local, state, and federal agencies on a variety of topics such as environmental impact assessments and mineral resources development, as well as outer continental shelf development, and the reclamation of mined lands.

A second avenue for dissemination is through publications which include *California Geology*, a monthly magazine, and scientific research reports.

The Department's Division of Oil and Gas has the role of encouraging the wise development of the state's oil, gas, and geothermal resources in a manner that prevents, as far as possible, damage to life, health, property, and natural resources.

Long-Range Planning Needs

As the nation's demand for adequate and reliable sources of energy increases, so has the need for the wise development of our oil, gas, and geothermal resources. The development and use of alternative energy supplies is a vital and growing component of our total energy program, although petroleum fuels will play a major role into the next century.

Many inquiries about oil, gas, and geothermal development are received by the department. As part of a program to handle these inquiries in a thorough manner, a wide variety of publications and maps related to oil, gas, and geothermal operations are prepared and distributed by the publications staff of the Division of Oil and Gas. Among the publications are field articles authored by division engineers and manuals describing recommended field practices written for oil, gas, and geothermal operators. An *Annual Report of the State Oil and Gas Supervisor* contains statistical data including production, injection, and reserve figures. Oil, gas, and geothermal field maps are published with field boundaries, well locations, and some well data. All of these publications are either distributed free of charge or sold at nominal cost.

Department of Fish and Game
1416 Ninth Street
Sacramento, CA 95814

The Resource

The Department of Fish and Game deals with the management of all wildlife resources within the state and coastal marine areas. Wildlife refers to all species of animals which are not domesticated, including aquatic animals, both fresh water and marine. Traditionally, wildlife has referred almost exclusively to game animals but there has been more emphasis recently on the ecological and aesthetic importance of nongame wildlife.

Wildlife is only one component of a complex interacting web of plants and animals. The interrelationships between organisms and their environments form the framework of ecosystems through which forms of life are sustained and the environment is continually renewed. The type of ecosystem which each wildlife species requires to survive is referred to as its habitat.

Most forms of wildlife require a specific type of habitat in order to survive. Because of the close linkage between species and their habitats, a major responsibility of this department is to identify these habitats and work to preserve areas for the species to survive in adequate numbers. Fish and wildlife serve several purposes. Many species provide recreation for anglers and hunters. Others are nongame fish and animals, and in addition to serving a function within their habitat, they contribute to the general gene pool.

Long-Term Planning Needs

Spawning and nursery areas for salmon and steelhead need to be cleared and spawning populations need to be increased.

Species of fish which migrate to the ocean to mature but must return to their fresh water origins to spawn are known as anadromous fish. Usually the

spawning grounds are in streams and rivers, many of which are scores of miles upstream in the foothills and mountains. Among the anadromous species are salmon and migratory rainbow trout known as steelhead.

King (Chinook) salmon and silver (Coho) salmon are the only salmon that enter California rivers in significant numbers to spawn. Since the turn of the century, salmon and steelhead populations have declined approximately 60 percent. Salmon, which annually support a $57 million recreational and commercial industry, produced a catch of 885,000 fish in 1978. The steelhead sport catch approached 122,000.

The Klamath River system, largest of the coastal California rivers, currently supports approximately 66 percent of the king salmon and 15 percent of the silver salmon that spawn in California's coastal rivers. The 3600 square mile Eel River system is the second largest coastal river spawning area. However, the numbers of salmon passing the Benbow Dam Fishway on the Eel River in Humboldt County have declined dramatically since counting was begun. The most recent counts indicate that the king salmon runs are relatively stable but the silver salmon runs are continuing to decline.

The Sacramento/San Joaquin Valley river systems support the remainder of the salmon and steelhead resource in the state. King salmon are the only salmon of any importance in this system. There are four major runs each year—fall, late fall, winter, and spring.

Several problems related to the damming of California rivers have adversely affected the salmon population. For example, gravel deposits which are essential to the protection of eggs and young fish have been lost through sedimentation and erosion. Replacement gravel that normally is transported downstream from upriver areas is now held behind the dams. Heavy metal contamination from mining operations and changes in stream flow patterns are other factors related to dams. Predators and water diversions, limited nursery areas, and other hazards, also affect the survival rate of young fish between hatching and reaching the ocean. In addition, large numbers of salmon are caught from the ocean by commercial and sport fishermen.

The present status of wetlands and modified wetlands needs to be stabilized and additional wetlands need to be acquired or preserved through incentives to private owners.

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Of the approximately five million acres of wetlands which existed prior to European settlements, 91 percent have been lost. Coastal marshes have fared slightly better than inland marshes with about a 75 percent loss. Up to 94 percent of the freshwater wetlands of the Central Valley have been destroyed. Most wetland losses result from reclamation and water development projects related to agriculture, urban sprawl, and road construction.

Wetlands include a broad array of areas where land, water, and vegetation interact. They are generally inundated by enough surface or ground water to support vegetative or aquatic life that require saturated conditions for growth and reproduction. Some wetlands, such as vernal pools, can be saturated during the winter and dry out during the summer.

Wetlands are known for their value as habitats for wildlife. At least 50 fur and game species in the United States, exclusive of waterfowl, inhabit wetlands to obtain food, water, or protective cover. Wetlands are also essential to many aquatic species, both fresh water and marine, as breeding grounds and as nursery areas for the young until they are large enough to move into deeper waters.

However, the essential value of wetlands is their contribution to the natural food cycle and their great biological productivity which is sometimes said to be nearly ten times that of terrestrial land on a per acre basis. In these settings, dead plant matter and dissolved nutrients such as phosphates, nitrates, and ammonia act as the basic building blocks of the ecological food chain. Rich plant and invertebrate life flourish and they, in turn, support the fish populations as well as the feeding needs of birds and sometimes mammals.

Wetlands also serve a function of filtering pollutants and renewing water supplies, although this benefit can be lessened by overloads. Marshes, estuaries, and other types of wetlands are capable of removing inorganic nutrients, such as sewage phosphates and nitrates, and recycling them into the food chain, an expensive process when carried out in artificial systems created by humans.

Wetlands also filter stream flow sediments which settle in the bottom of the wetland and eventually bring about its demise through infilling. If natural processes are not interrupted by man's activities, in time every marsh becomes a wet meadow or upland, although the process, as it proceeds

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naturally, can take thousands of years. As the watersheds around wetlands are stripped through timbering, development, and other activities, the delicate water-soil-vegetative balance can soon be overcome. The sedimentation rate is accelerated, water circulation is reduced, and stagnation and eutrophication tend to kill off the natural inhabitants and create breeding grounds for mosquitoes.

The Central Valley wetlands are particularly important as a stopping point and terminus for the Pacific Flyway which covers the western portion of the North American continent and portions of the Artic and eastern Asia. Most waterfowl using this flyway are hatched in the praries of western Canada and the river valleys and deltas of Alaska. Most of these birds winter from Washington to Mexico for about 60 percent of the flyway's total population. Approximately 10 to 12 million ducks and geese, accompanied by hundreds of thousands of shorebirds and other water-related birds, annually winter or pass through the Central Valley.

Key habitats need to be acquired, restored, and maintained for more than 300 species of fish and wildlife in California, including 212 presently identified species of rare, endangered, or threatened plants and animals.

Our understanding of the environment and the complex web of relationships that are essential to its successful functioning is still largely a mystery. The delicate balances which are characteristic of a single ecosystem fan out in every direction into the creation of increasingly complex balances with other living and nonliving organisms that are parts of other ecosystems until the entire planet can be seen as one ecosystem. The central and profound question faced by every expert in resource management is to discover where to enter into the solution of an environmental problem. This is the question faced by fish and wildlife managers in determining the choice of habitats that will generally enhance the welfare of our entire wildlife populations and, at the same time, enhance the quality of life for the inhabitants of our state, nation, and world. For this reason, probably the best approach to understanding the needs for habitats that can accommodate and nurture as many species of wildlife as possible is to describe the research and the types of knowledge about our environment, its inhabitants, and mutually shared habitats that we will have to develop within the near future. Listed below are a number of research topics that need to be studied along with the ongoing acquisition, restoration, and maintenance of habitats.

- Learn how judicious management can be applied to achieve harmony between the needs of wildlife and other uses, such as road construction, timber harvesting, and land use for recreation.
- Determine the ideal habitat conditions for various species of wildlife in different locations and at different points in their life cycles.
- Determine instream flow needs of fish populations on a stream-by-stream basis.
- Develop a marine nearshore habitat-type inventory, cataloging the habitat types in the nearshore marine ecosystems so that changes in the ecosystem can be evaluated and specific effects determined.
- Learn how the habitat requirements for wildlife species may conflict with other uses, such as the use of forest forage by domestic animals as well as wildlife.
- Identify the effects of bird populations on controlling insects which damage valuable timber species.
- Appraise damages to forest vegetation caused by wildlife species and determine acceptable control methodology.
- Study the effects of timber harvesting on livestock grazing on food and cover for different species of wildlife.
- Identify the characteristics of prime-fish habitats and determine the effects of land and water management.

Department of Forestry
1416 Ninth Street
Sacramento, CA 95814

The Resource

The Department of Forestry, located within the Resources Agency, and operating under the policies of the State Board of Forestry and Public Resources Code, is responsible for providing fire protection and watershed management services for the protection of private lands and state-owned lands in California, outside of the incorporated cities.

California includes a total land area of 100,191,000 acres. It is the third largest state in the country in terms of land area. About 33 percent or 32,558,000 acres are classified as forest areas. However, only about 16 percent of the total land area of the state is considered as commercial forest lands. These are forest lands that are suitable for growing and harvesting timber in a continuous cycle. The total resources managed by this agency include about 33 million acres of timber lands, range lands, and wildlife and fish habitats. Any public area with about 10 percent of forest cover is considered to be forested whether it is used for recreation, range grazing, or other purposes.

There are two major forest regions in the state. One is an intermittent strip stretching 450 miles along the coast from Monterey to the Oregon border with a maximum width of 40 miles in some places. This is the habitat of the California redwood along with other important commercial tree species such as the Douglas fir and white fir. The world's tallest tree, a 367-foot coast redwood, is located in this area in the Redwood National Park. The second major forest area is a pine region that extends the full length of the Sierra Nevada and along the inner mountain ranges from Oregon southward to just north of San Francisco Bay. The principal species in this region are ponderosa, jeffrey, white fir, red fir, and some hardwood species.

California ranks second in lumber production in the country; 35 to 40 percent of the timber harvested comes from the national forests. The balance comes from privately owned tree farms. Californians also consume more products based on wood processing than any other state in the nation. These products include labels, printing papers, newsprint, packages, furniture, and charcoal briquettes. As our technology increases, the processing of wood-based chemicals is becoming a new and important industry with widespread applicability. One example of a wood-based chemical is torula yeast, a high protein product made from wood sugars spent in the pulping process. One variety, Type S, is used in baby foods, cereals, baked goods, and beverages. Type F is used in feed supplements for commercial domestic animals. Still another variety, Type FP, is used in pet foods. Other wood products, such as ethyl cellulose and similar chemical-based celluloses, are used in making a variety of products including football helmets, photographic films, medicines, fertilizers, and cosmetics.

Forests also provide us with another resource that we are just beginning to recognize. That is clean air. Through transpiration, the forest gives up moisture and oxygen to renew the earth's atmosphere. The present climate of the earth is partially determined by the size and location of forest lands on the planet. The effects of forestation on climate are immediately noticeable in urban areas where natural growth serves a variety of functions.

The forests also provide the habitats which are indispensable to the maintenance of living organisms of all types. Many species of birds and other wildlife animals depend on various stages of forest succession for their habitats. Even the anadromous fish such as salmon and steelhead that spawn in California rivers depend on a forested watershed for the water supply that makes possible their annual journeys up the streams and rivers. Domestic animals that graze on the rangelands under management by this agency are a source of food and other materials which are important for the maintenance of our lifestyles.

Long-Term Planning Needs

Growth and harvest of timberlands needs to be managed to assure a consistent yield and continuing renewal of forest resources.

Timber production in California has steadily declined for the past two decades. This is due partially to the withdrawal of commercial timberlands for other uses such as parks and wildernesses, as well as commercial development. The Forest Service classified 7.6 million acres of privately owned land in the state as commercial forest land. Information available about the condition of these lands is spotty and the annual yields vary widely.

The most dependable source for timber production is approximately 2.7 million acres of commercial forest land owned by companies with forest product mills. An additional 1.5 million acres are owned by companies that regularly supply the mills. These companies manage their lands on a continuous yield basis. The total acreage in these ownerships is increasing and the number and size of these holdings has been changing generally toward fewer and larger companies.

At present about 35 percent of the harvested timber comes from the national forests and the remainder comes from privately owned tree farms. Continued conversion of private commercial forest land to nonforest use if

decreasing the productive capacity of the state to provide the needed timber. However, under recent legislation, counties can designate land as Timberland Preserve Zones (TPZ) which can be used only for production of forest products. Tax allowances are also granted which make the investment profitable. By 1978, 75 percent of the private commercial forest land was in TPZs.

The old growth inventories are continuously being reduced and replaced by young growth through commerical harvesting and reforestation. Replanting is making the California forests more ecologically diverse than ever before. However, the overall quality of timber is reduced as the young growth increases and the old growth decreases. Parks, wilderness areas, and other preserves are becoming the last refuge for old growth.

Reforestation of 1.4 million acres of timberland, mainly in private ownership, is an important need for the immediate restoration of the productive capacity of the commercial timberlands. State cost-sharing plans are in operation to encourage the reforestation of privately held lands. Vegetation management programs also are being implemented in young timber stands to increase forage production, water yields, wildlife habitat, survival of seedlings, and growth rates. Through vegetation management, damages from fires and soil erosion are expected to be diminished or averted.

Massive urban reforestation is needed to improve the quality of life in these areas.

When the 1978 legislature passed the Governor's Urban Forestry Program, it began a new era for the California Department of Forestry. Ninety-four percent of the population of California lives on two and one-half percent of the land. Many of these areas are currently losing trees faster than they are replaced through insects, diseases, old age, vandalism, and urban development.

Forestation in urban areas offers many advantages for improving the physical and visual impact of the environment. For example, carefully placed trees can shield a building from the sun's direct rays during the summer more than during the winter. Shrubs can also shield walls from direct heat of the sun. Vegetation cools the environment during hot weather by reflecting much of the sun's rays, unlike concrete that absorbs the heat all day and radiates it at night to raise the ground temperature. Trees also create breezes by attracting warm group air up as coolness is created by transpiration through leaves. Equally important is the aesthetic impact trees, shrubs, and other plantings have on the appearance of our environment and our mental well-being. They also provide an urban habitat for animals such as song birds and, in some areas, ground animals such as squirrels. Urban forestation also reduces noise pollution.

Several aspects of urban forestry are currently under study as part of a nationwide project sponsored through the Federal Forestry Service. One task is to select trees and other plantings that require minimal supplies for the semi-arid urban environments that characterize California. In some areas, deciduous trees that lose their foilage during the winter are most desirable for use in energy conservation. During the summer, they provide shade protection from the heating effects of the sun's rays. However, during the winter the sun's less powerful rays can permeate the bare limbs and provide heat. Another thrust is to develop resources and values that will cause people to participate in urban reforestation programs. Already, in many parts of the state, groups are working to recruit volunteers for major replanting projects.

Urban reforestation, to be sustained over years, will depend on cheap and readily available supplies of seedlings and young trees for replanting. This will require the establishment of urban greenhouses and other urban sources for the acquisition of all types of planting. Because of the newness of the program, these facilities are still in the planning stages with consideration for such factors as optimal locations for creating urban employment and the variety of plants and trees that would be most desirable for a particular urban location.

Forest fires are a major threat to the depletion of our forest resources, the loss of wildlife, and the destruction of built environments.

California leads the nation in its unique wildland fire problems. The historic approach of adding more expensive and sophisticated fire suppression forces can no longer be maintained. It is not only too costly but the end effects of relying on this approach exclusively are less productive than other methods.

One approach that holds promise for reducing the threats of fires is to reduce the fuel loading of old growth within the forest and on chaparral lands. This requires regular and controlled burning off of the undergrowth

in the forest and on the open chaparral lands. By purposely burning off the shrub undergrowth before it becomes too thick, fire temperatures can be kept within the range that will not be damaging to the established tree growths. However, by allowing the undergrowth to build, when fires are started, the heat becomes intense enough to destroy all plant life including the trees. Burning off the chaparral areas, allows for the gorwth of grasses and other plants less dangerous in terms of being fire hazards. Interestingly, it has been established that wildlife populations prefer forested areas in which the undergrowth is kept down. Thickly forested areas with excessive amounts of underbrush are generally avoided by wildlife populations. Hence, this resource management technique also benefits preservation and growth of wildlife in the forested areas.

Research needs to be conducted and methods developed for the use of residues from timbering and waste materials from forest clearance as an energy source.

There is a long list of benefits that could occur from the systematic harvesting of wood residues for energy production. For example, wood is a renewable, biodegradable, and naturally stored fuel. Clearing forests of the undergrowth that creates devasting forest fires not only ameliorates that problem, but also decreases the need for hazard reduction burning. Clearing forests of logging residues for the production of energy is an added stimulus for improved silva-cultural practices which can offset some forest improvement costs.

Wood conversion technologies are relatively simple and potentially more reliable than technologies using coal and oil. This source of energy can be refined and packaged in rural areas, providing employment and self-sufficiency for these areas. It is also a potential source of income to landowners who can clear their own lands and sell the waste materials to a local wood conversion operation.

Several avenues for the eventual use of this resource are currently being explored. For example, one project explores the use of hardwood-encroached lands. The hardwood timber is used for energy production as the lands are replanted with softwoods, more useful in commercial timber production. Other studies are being conducted on the economic feasibilities of using wood as an energy source. One project conducted jointly by the California Energy Commission and the Department of Forestry is demonstrating the technical and economic feasibility of using a gasifier/engine generator system to supply electrical requirements for a conservation camp operated by the Department of Forestry. Eventually, a step-by-step procedure for establishing similar systems throughout the country will be produced.

Studies are also being conducted on the effects of the clearing of logging residue and underbrush on the nutrient cycles in different areas. At present, these studies show no adverse effects. Urban parks, such as the Golden Gate Park in San Francisco, generate large volumes of wood residues from maintenance and replacement activities. The Golden Gate staff, in collaboration with the Department of Forestry, has developed a program to use the residues, providing an alternative to conventional heating fuel sources and mitigating the problems of residue disposal.

Department of Parks and Recreation
1416 Ninth Street
Sacramento, CA 95814

The Resource

About six million acres of California's mountains, deserts, and coast are managed for park and recreation purposes by various federal, state, and local agencies. The California Department of Parks and Recreation, as part of its overall responsibility for statewide planning and policy in the park and recreation field, manages about one million of these acres within the California State Park System. This includes some 250 state parks, beaches, wildernesses, natural preserves, historic sites, and recreational areas throughout California.

The State Park System accommodates more than 60 million days of visitor use each year in camping, picnicking, fishing, boating, sightseeing, and a hundred other activities, including many kinds of environmental learning experiences.

Everyone thinks of parks as places for recreation where you can hike, swim, picnic, or play baseball. One of their important purposes is to provide a

release from physical tensions, a health-building experience. They also serve as a unique setting for understanding our history and our cultural heritage. But most importantly, they are places where men and women may come to discover, understand, and appreciate the interrelationships and interdependencies between people and their environment. They are a means of making us aware of the world around us. They provide a chance to see that world as it is naturally, not as modified by other human beings. They expand our sense of values beyond the merely economic. They provide an opportunity for contemplation, reverie, solitude, and peace. They are "islands of hope."

Long-Term Planning Needs

Increasing public demand needs to be met, while sustaining the high quality park experience.

Park use continues to increase at an even faster rate than the state's population. Thousands are turned away at popular parks and recreation areas during peak vacation periods. Existing facilities are strained, sometimes even to the detriment of the resource itself as when deeply rutted trails erode a meadow, or constant use of a campground compacts the soil and suffocates redwood roots.

Lands that are suitable and available for park use are not unlimited, and competition for land of any kind is becoming increasingly intense. Costs for both acquisition and development continue to rise. Funding to operate and maintain existing facilities becomes more difficult to obtain. Comprehensive long-range planning is essential to meet human needs while preserving the environmental quality on which all else depends.

More urban parks need to be developed and many that exist need to be upgraded.

Ninety-four percent of California's citizens live in urban and suburban areas on two percent of the land. Urban parks and recreation areas are essential in many ways to the preservation of our health as a society. Often, they provide the only open space for relaxation and recreation in congested areas. Urban parks with natural growth such as trees and bushes reduce pollution, reduce noise, alleviate temperature extremes, reduce energy consumption, provide soil and watershed protection, improve urban wildlife habitat, and beautify neighborhoods. They also often serve as the only continuing contact which people have with the natural environment, and provide an aesthetic quality that exists nowhere else in an urban area. The importance of urban parks is now being recognized, and they can be expected to receive increasing attention in the years ahead.

Parks and their programs need to serve a broader population, particularly minorities, the disabled, and the elderly.

Many of those who most need the benefits parks can provide are unable or disinclined to use them. A major effort in park systems at all levels is to make park and recreation facilities more accessible to the disabled, to develop programs that will more effectively serve minorities, the elderly, and other populations with special needs.

There is a need for greater public involvement in planning parks and in operating them.

Public involvement is being increasingly recognized as the foundation for good planning. People need to participate in all stages of the planning process so it can be responsive to their needs. And they are needed more than ever when the plans come to fruition; many park programs would not exist without the help of dedicated volunteers. Parks need people as much as people need parks.

New strategies must be found to help parks become more self-sufficient economically.

Park values should not be measured solely in terms of economics, but neither can economics be ignored. Parks must compete for public dollars, and the more nearly they can become self-supporting, or find ways to offset some of their costs, the better they may be able to afford some of the things that do give parks their highest value.

There needs to be a new look at how people get to parks.

In spite of people's reluctance to abandon their cars, transportation patterns may be changing. It's becoming less and less feasible to travel halfway across the country to go through 20 parks in as many days. The cost-conscious are staying closer to home and remaining longer in one place. Interest in public transportation is reviving. Park planners, hopeful that the

day of giant parking lots is passing, feel whole new concepts may be necessary.

How to use parks in environmental education

You don't have to go to Pt. Lobos to learn about the natural environment. A patch of weeds at an asphalt playground will illustrate most environmental principles. But, because these great places are outstanding, they command attention. A trip to the redwoods or the desert makes a lasting impression that no child can forget. A wilderness experience can only be had in a wilderness.

Learning about how people lived in an historic period can give perspective on how we live today, on the choices we make about how we use our environment. And there is a profound difference between actually going to a place and just reading about it. That's not to say you should overlook the park next door, either. It, too, can offer a variety of habitats, of plants and animals—and, all too often, a drastic contrast with its surroundings—that can be used in a lot of teaching ways.

The California Department of Parks and Recreation has environmental living programs at several of its units, where classes can stay overnight and "re-live" the life of an historic period. But these programs can only handle a relatively small number of classes and are usually booked far in advance. Some parks have shorter, daytime programs of a similar nature. Efforts are being made to mesh the park system's offerings with this new statewide environmental education curriculum, and most parks have at least some informational materials on the resources they have available. At the very least, there is almost always a ranger with whom you can discuss your needs.

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Department of Water Resources
1416 Ninth Street
Sacramento, CA 95814

The Resource

The Department of Water Resources provides leadership for the management of California's water resources. The Department's programs are designed to implement a California constitutional requirement that the state's water be put to the fullest possible beneficial use, and that waste and unreasonable use of water be prevented.

Water, seemingly, is everywhere. It covers three-fourths of the world's surface as a liquid. It is also present in the atmosphere in a gaseous state and large amounts exist in a solid state as the polar ice caps. The water in the oceans and the ice at the polar caps comprise 99.3 percent of the water on the planet. The remaining 0.7 percent, at any one time, exists in the atmosphere, lakes, rivers, soil, and subsurface deposits. Water is the primary constituent of all animal and vegetable matter and the processes of life depend on a constant interchange of water between living matter and the environment.

California has 12 hydrologic basins into which water from precipitation flows. The total annual supply of water in California is estimated to be 31.3 million acre feet, although average annual precipitation amounts to about 200 million acre feet. (An acre foot equals approximately 326,000 gallons.) The difference between precipitation and availability is lost for human use through evaporation from the surface of vegetation, ground, and water, through transpiration from vegetation, and through runoff to the oceans.

The runoff from precipitation in these twelve basins is the major source of the water we use. Most of the state's runoff occurs in the north coast and the

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Sacramento basins. This is also where the two major forest areas in the state are located, one running down the coast from Oregon and the other following the mountain ranges to the east of the valley from Oregon to the San Francisco Bay Area. In terms of both water supply and water quality, the condition of the flora in the upper regions of a runoff basin is critical. The high, steep portions of the basin usually receive the largest proportion of the rainfall and the vegetation on these slopes, if it is thick, prevents the erosion of soil, allows the runoff, and enhances absorption of the water into the soil, ensuring a well-regulated runoff flow and good quality water.

The second major source of water supplies is the underground deposits called aquifers. These are natural reservoirs which water seeps into and is stored. Aquifers develop very slowly over long periods of time that can range to thousands of years.

A quick survey of the figures for average annual runoff in each of the basins reveals that there is an uneven distribution of rainfall and the need for water in California. The largest population centers are in the south were the least amount of rainfall occurs and the water reserves are the smallest. Similarly, the San Joaquin and Tulare Lake basins are the sites of a large percentage of the most productive farmlands in the state. Water management practices, traditionally, have developed storage and transport systems—dams, reservoirs, canals, and aqueducts—that can ensure a constant supply of water from the high rainfall areas to where it is needed.

Human needs for drinking water are far less than needs for washing, flushing toilets, and other ways in which water is consumed in daily living. Industrial needs consume considerably more water in manufacturing processes and in generating power than humans do in daily living. Agriculture, however, is the single most water-consuming activity in the world. In California, agriculture uses 85 percent of the total amount of water consumed in the state. Most of this is lost through transpiration as crops mature and through evaporation as the land is irrigated. Following are estimates of some water requirements:

USE	AMOUNTS REQUIRED	
	Liters	Gallons
Drinking water (adult daily)	1	0.26
Toilet (one flush)	20	5.28
Clothes washer (one load)	170	44.88
Refine a ton of petroleum	2,000 - 50,000	528 - 13,200
Produce a ton of steel	6,000 - 270,000	1,584 - 71,280
Grow a ton of wheat	300,000 - 500,000	79,200 - 132,000
Grow a ton of rice	1,500,000 - 2,000,000	396,000 - 528,000
Produce a ton of milk	10,000,000	264,000
Produce a ton of beef	20,000,000 - 50,000,000	528,000 - 1,320,000

Long-Term Planning Needs

Present overdrafting of groundwater supplies is threatening the availability of a continuously dependable supply of water in the future.

Groundwater is stored in aquifers which are natural underground reservoirs in porous rock below the soil surface. The location of aquifers is dependent on the permeability of the soil and rock layers in an area. Groundwater, obtained through drilling wells, is the cheapest and most accessible alternative to surface water supplies. When groundwater is withdrawn at a rate greater than the recharge rate, the water table drops, increasing the depth to which wells must be drilled. Since drilling costs increase rapidly with depth, withdrawing the groundwater can become uneconomical. In these cases, aquifers can be thought of as a nonrenewable resource that has been mined out. Often, not only the groundwater resource is lost. Surface streamflows can be severly reduced with the lowering of the water table and ecologically important wetlands can dry up. In coastal areas, depletion of freshwater aquifers can lead to the intrusion of saltwater, and, again, permanent loss of the resource.

Groundwater supplies have been permanently depleted in parts of Arizona and in the high plains of Texas where water tables have fallen up to 30 meters. The principle overdraft area in California is the San Joaquin Valley where the safe yield of groundwater is exceeded by 1.7 million acre feet each year. Without other supplies of water, a region can suffer a serious decline economically and in other related ways. Moreover, the decline in groundwater supplies also threatens the maintenance of a dependable supply of water in dry years and can also cause economic decline because of periodic droughts. In some areas, development moratoriums have already been declared because of serious declines in the water table.

There are two basic approaches to dealing with the problem of overdrafting groundwater. One approach is to develop a comprehensive statutory system of groundwater law. This requires the establishment of groundwater management areas based on the survey of geological conditions and the identification of major groundwater basins.

The other approach is to recharge the aquifers during wet years using technology that will allow for quick absorption of the water by the porous rock. Aquifers, in one way, are very preferable to surface reservoirs because of the evaporation problem which can be particularly severe in hot, dry areas. For example, losses through evaporation at Lake Mead have been measured at one cubic kilometer per year or about 4,500 liters (1,190 gallons) for each person in the United States.

Waterlogging and salt accumulation on irrigated lands is threatening agriculture production.

Waterlogging, salinization, and alkalinization commonly occur when irrigation systems, particularly in arid lands, don't allow for proper drainage. As the water flows through the soil, salts and other solid deposits are filtered out and these accumulate. The San Joaquin Valley is the region most seriously affected by this problem. About 400,000 acres at present have high brackish water tables that pose a threat to the productivity of the land. When the water table reaches the root zone productivity is sharply curtailed. It is estimated that 700,000 to one million acres will seriously be affected by this problem by the year 2000. Lost crop production could reach $320 million annually by the year 2000. One approach to this problem is to install subsurface drainage systems for individual fields and a master drain for a large area. This can be very expensive both initially and in the maintenance of the system to assure continued adequate drainage.

A more economical approach is to grow more salt tolerant crops such as barley, cotton, and sugar beets. Studies are being conducted to test the effects of brackish water on these types of crops.

A third approach is to build desalting plants. So far, however, the desalting process has been very expensive. In 1975 there were about 700 desalting plants in the world but almost none were used in agriculture. Larger plants averaged a cost of around 15 cents per cubic meter and smaller ones ranged from 25 to 50 cents. This price excludes use for all but very high-value crops such as tomatoes, avocados, and orchards. Experimental plants are in the design stages using biomass conversion, solar pond power generation, and recovery turbines in conjunction with ponds and marshes in an attempt to reduce the cost of the desalted water.

Widespread water conservation practices can reduce the need for developing new water supplies in the future to meet the needs of an increasing population and industrial growth.

The most economical and environmentally safe way of increasing the real

supplies of water is to conserve through reduced consumption, using the existing supplies more efficiently. However, probably because of the widespread presence of water and its importance for our existence, it has not often been thought of as have other natural resources such as petroleum, minerals, and coal. As a consequence, the methods for water management and use have been quite different from those methods used for the other natural resources. For example, water has historically been very cheap regardless of the supply, and even in areas or times of shortage it has been put to low-value uses such as watering lawns or filling swimming pools with no regard for the consequences to higher-value uses. Water consumption has been accepted almost as a personal right. Instead of placing limitations on its use and practicing conservation, emphasis has been placed on transferring supplies from one water basin to another which sometimes has had disasterous environmental consequences.

In fact, a substantial part of municipal water use in the United States is the result of leaks, including running toilets, and dripping faucets as well as letting a tap run unnecessarily. Retrofit devices have been used effectively to reduce consumption. For example, 35 major urban areas throughout the state showed a 21 percent reduction in water use in 1977 compared to 1976. Water conservation has persisted to the present time and is still 17 percent less than in 1976.

Industrial uses also account for much of the wasted water. A good proportion of quantities required by industrial processes can be recirculated instead of being permanently withdrawn from existing reserves.

Irrigation, the prime consumer of water in California, can be managed more efficiently from the standpoint of water consumption. For example, high frequency irrigation, using smaller amounts at more frequent intervals and through pipes, has the potential for saving considerable amounts of water. The use of computers in this operation has the potential for further increasing conservation effectiveness. As mentioned above, planting crops that are more tolerant of the salt content of water is another way in which agriculture can increase its efficient use of water.

Probably the most effective means for conserving in the consumption of water will be found in adjusting prices to reflect the scarcity of this resource in a particular region. Heretofore, society has subsidized people living in arid regions by making the cost of water artifically low. Through pricing

practices that reflect the actual scarcity of the commodity and ajustments to prevent the demise of industries such as agriculture, it is hoped that water management practices will be brought more in line with the economic laws that govern scarcities of the other natural resources.

Water distribution systems need to be further developed to meet the expected needs for water by the year 2000.

Projections place the demand for dependable supplies of water in California at 4 million acre feet annually by the year 2000. With effective conservation programs, this figure can be reduced to 3.4 million acre feet per year. As noted above, the major areas for water supply are in the north and the areas of greatest need are in the San Joaquin Valley and the coastal areas in the south. The source with the greatest potential for supplying water is the Delta region in the Central Valley. It is here that the flows from the Sierra Nevada, cascading down the western slopes in a myriad of streams, converge in the Central Valley to form the greatest river system within the boundaries of a single state in our country.

Some of the problems related to using this area as a major source of supply for other parts of the state are political and some are environmental. Often, in the past, water has had a peculiar local nature that is not attached to other natural resources. Some areas can enjoy an abundance while adjacent areas suffer from a scarcity. People and industries upstream can pollute water through a variety of ways such as the runoff from fertilizing practices without regard for the consequences to people's needs further downstream. In other cases, upstream areas can siphon off most of the water supplies for activities such as irrigation and leave inadequate amounts for those areas closer to the mouth of the river or stream.

The use of water from the Colorado River is a case that illustrates both of these points. Originally, Mexico was not included in the water sharing agreement and, as a result, very little flow was left by the time the Colorado River reached that area. Salinization from irrigation later became a problem when it reached such high proportions that the water, once it crossed the Mexican border, was virtually useless. Fortunately, both of these problems have been settled in an amicable way.

The political power manifested in the sheer numbers of people in the southern coastal region has been perceived, in some instances, as the only

reason why water diversification projects are being planned. Extreme sentiments against these plans in the northern areas have led to abortive threats to take actions such as seceding from the state.

There is also the fact that plans to divert large amounts of water from the Delta to the southern areas will produce negative environmental effects in the north such as the influx of saltwater through the San Francisco Bay and the Carquinez Straits. Others say that controlled releases of water to the Delta would protect the San Francisco Bay-Delta Estuary and the Suisun marsh while also providing good quality water for transport to the southern part of the state.

The controversy surrounding the movement of great amounts of water from one basin to another is being experienced in other parts of the world such as in the controversy that erupted between India and Bangladesh when the former drained much of the water out of the Ganges River to flush out the Calcutta Harbor and seriously depleted the supplies needed for irrigation by its neighbors.

All of these problems are, in turn, an indication that people and nations all over the earth are becoming more aware of water as a limited natural resource. As demands on the available water increase, this resource is being viewed more as other natural resources are and is being subjected to the same economic laws that regulate their use.

State Lands Commission
1807 - 13th Street
Sacramento, CA 95814

The Resource

The State Lands Commission acts as the manager for about 4.5 million acres of land held in trust for the people of California. One portion of these holdings, about 4 million acres, was acquired as sovereign lands when California joined the Union in 1850. Approximately the size of Connecticut and Delaware combined, these lands include the beds underlying about 30 navigable rivers throughout the state such as the Klamath and Sacramento, the basins of almost 30 navigable lakes such as Lake Tahoe and Clear Lake, and the three-mile-wide strip of tide and submerged land adjacent to the coast and offshore islands.

The other portion of these lands, about 610,000 acres, is the remainder of a federal grant made to California shortly after statehood to support public education. In that grant, the state was given two square miles out of each 36 square miles held by the federal government. Originally, that amounted to about five million acres, most of which was quickly sold to private holders. The remaining portion, no longer subject to sale, is currently being consolidated through exchanges with other public land holders into larger blocks that are more economically useful.

The Commission is composed of two elected public officials, the State Controller and the Lieutenant Governor, and one cabinet level officer appointed by the Governor. This composition was determined in 1938 when the Commission was formed to assure that public interest in the use of these vast holdings would be safeguarded. Revenues from the original school lands are still used for support of the public school system.

Long-Term Planning Needs

Energy and resource development on the lands managed by the Commission needs to be promoted and guided by the procedures that will provide the most benefit for the citizens of California.

Oil and gas deposits on state lands, particularly in the tidelands and submerged offshore areas, are an important resource that is being developed through the collaboration of the public and private sectors. Average daily production of oil on state lands is approximately 100,000 barrels. Revenues for 1981-82 are estimated to be enough to enable the Commission to produce more revenue than any other nontax state agency. The Commission has successfully formulated firm procedures to avoid oil pollution accidents caused by wells on state-owned lands as evidenced by the fact that not one major incident has involved wells located on lands leased by the state. One reason for this successful record is that potential environmental impacts are rigorously assessed before any drilling operations are allowed.

The largest geothermal electric generating complex in the United States is located in Sonoma County at The Geysers. More than half of the steam used to generate electricity at this site comes from state geothermal leases. Over a half million acres of state-owned land are located in regions with geothermal potential although only a small portion of that area has been explored. The Commission's task is to promote full use of these resources

while safeguarding environmental quality and maximizing economic benefits to the public.

Other resource development activities include timber harvesting and grazing leases on the remaining school lands. Additionally, although the state sold large portions of the original school lands grant, mineral rights were retained on 716,000 acres. Consequently, now the Commission leases some of its rights for mining operations and collects royalties for the production of sand, gravel, precious metals, iron, and other minerals.

General development of lands managed by the Commission needs to be promoted in a manner that safeguards public use of all navigable waters within the state.

Almost since California became a state, the legislature has granted tide and submerged lands in trust to cities and counties so that these regions could develop harbors and waterfronts in accordance with locally developed plans. In many places, these granted lands have been developed into marinas, harbors, aquatic parks, and other types of recreational areas. Although these lands are under local control, the Commission has responsibility for monitoring the sites to ensure compliance with the terms of the statutory grants. These grants, traditionally, have been designed to encourage the maximum development of tidelands in a manner that is consistent with the public's best interest while requiring the grantees to reinvest any revenues produced back into the lands where they are generated.

The Commission also has authority to issue permits for the dredging of harbors and waterways that have become obstructed with mud or silt. These permits are granted to both public and private parties. Other dredging initiated by the Commission is done to improve the configuration of the shoreline and to reclaim private and public lands.

The Commission also has responsibility for two public service projects. One project resulted from the 1977-78 drought. When waters receded as a consequence of the drought, a large number of hazardous objects such as pilings, discarded junk, and other large objects were discovered within the navigable waters in many areas. The Commission has been given responsibility for a massive undertaking to identify these hazards and remove them. Current efforts are being concentrated in the areas of Lake Tahoe and the Sacramento/San Joaquin Delta. These efforts also include the removal of abandoned oil drilling equipment in the tidelands and submerged areas.

The second project, to clarify water boundaries, is the result of more intensive use of waterfront lands. Because land was abundant and put to low density use until recently, many early land descriptions which involved water boundaries were vague and uncertain. Within the last 50 years the determination of these boundaries has become a problem of increasing proportions. Now, it is estimated that more than 7,000 miles of common water boundaries between public and private lands are in dispute. The Commission has relied on historical records, maps, minutes of public meetings, archives, and interviews with historians and local longtime residents as some of the sources for resolving these disputes. The resolution of these land title problems is important not only to protect the public's resources, but also to enable private parties to obtain sufficient title insurance.

State Solid Waste Management Board
1020 Ninth Street, Suite 300
Sacramento, CA 95814

The Resource

In 1972 the California State Legislature established the State Solid Waste Management Board to develop and maintain a state program of nonhazardous waste management and resource recovery which would protect public health and safety, promote economic productivity and environmental quality, and conserve natural resources.

Californians generate about 46 million tons of nonhazardous waste each year and pay approximately $600 million annually to have it disposed of in various ways. Presently, most solid waste is landfilled. However, landfill sites are becoming less available, and it is anticipated that only three-fourths of the present capacity for disposing of solid waste in this way will exist by the end of 1990. Unless other options for the disposal of solid waste can be developed by that time, California will be faced with a serious garbage crisis.

The Legislature acted in 1977 through SB 650, the Litter Control, Recycling and Resource Recovery Act, to give the State Solid Waste Management

Board responsibility to develop public awareness of the crisis, foster a new ethic toward waste disposal, and develop new systems to recover materials and energy from garbage. The board's management activities include state and local planning, enforcement of environmentally sound landfill practices, recycling, resource reuse and energy recovery, litter control, waste reduction, and public education.

Long-Term Planning Needs

Fortunately, there are alternative systems to landfill disposal of solid waste. However, each of the options has advantages and disadvantages that need to be taken into consideration when developing a long-term plan for solid waste management. The following assessments describe alternative methods for dealing with the growing waste generated by our society.

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METHOD: Waste Reduction

Waste can be prevented at its source by altering manufacturing processes, product and packaging design, patterns of consumption and waste generation to conserve natural resources and energy, and to extend product lifetime. Examples include purchasing products with minimal packaging, manufacturing more durable and fuel-efficient products, and reusing products rather than disposing of them.

	PRO	CON
ECONOMIC	Reduces municipal disposal costs. Reduces energy used in manufacture. More efficient use of natural resources. Can create new job opportunities.	Major capital investments for industry. Intrudes on free enterprise system. Loss of feedstock and revenues for resource recovery projects. Can create job dislocation.
ENVIRONMENTAL	Reduces litter and pollution. Preserves natural resources. Promotes efficient land use.	Sanitation problem from storage of reusable food containers.
TECHNOLOGICAL	Existing technology is used to create more durable products.	Additional research needed to create more recyclable products. Product design technology is insufficient.
IMPLEMENTABILITY	Can be done by all sectors. Requires minimal initial effort by consumers.	Resistance to change in behavior by citizens, government, and industry. Lack of external incentives discourages participation. Conflicting data impedes decision making. Inadequate public awareness.

CONCLUSION

Waste reduction is the initial and most important alternative to solid waste disposal. However, it is a highly complex and controversial issue because it is intertwined with philosophical considerations regarding the role of government; the functioning of the free market; the relative value of social, economic, and environmental factors; and concepts regarding the quality of life as measured by the consumption of material goods.

METHOD: Landfill

Landfills are now the final repository for most solid wastes. The wastes are unloaded, compacted so as to reduce the volume, and covered with soil.

	PRO	CON
ECONOMIC	Inexpensive alternative (approximately $3-5 per ton). In some cases, energy recovery from landfill-produced methane gas may be economical.	Landfill costs are expected to increase because of increased haul distances and compliance with environmental standards. Capital costs for land close to waste sources is increasing due to urban development.
ENVIRONMENTAL	Previously unusable land (e.g., gravel pits) have been reclaimed for some social use.	Use alternatives for usable land are limited. Poor operations may result in odors, propagation of disease vectors such as flies, groundwater pollution, and/or migration of explosive gases. Most landfills will be energy consumptive. Energy and material resources in the wastes are lost. Even with gas-recovery energy resources are not fully used.
TECHNOLOGICAL	No new technology is required for existing practices in landfill operation.	Environmental monitoring, control, and cleanup techniques for odors, gas migration, and groundwater pollution are not well developed.
IMPLEMENTABILITY	Landfills are needed for residuals of any alternative.	Poor landfill operations create adverse public impressions, creating barriers to obtaining land-use permits.

CONCLUSION

Landfill is perceived by the public to be less desirable than resource recovery and common belief is that landfills are obsolete, unneeded, unacceptable, and a waste of resources. Its economic advantages will rapidly diminish with increased haul costs. The requirements for new landfill will not disappear but will be diminished by implementation of resource recovery.

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METHOD: Composting
Organic wastes (paper, leaves, food, etc.) can be converted into humus-like compost through aerobic (with air) bacterial decomposition.

	PRO	CON
ECONOMIC	Small scale composting is not capital intensive.	Large scale composting is capital intensive. The commercial compost market is very limited and is currently being served with compost made from other wastes (sewage, sludge, manures, wood bark, etc.).
ENVIRONMENTAL	Represents a closed loop ecological cycle whereby substances grown from the land are ultimately returned to the land for recycling. Improves soil and increases productivity of humus-deficient soils. Reduces landfill space requirements by 60-70 percent.	Composting is energy consumptive; requires approximately 1.5 gallons fossil fuel per ton of compost or 1,500 BTU/lb. to process. Heavy metal impact on crops from sludges are under study. Odor, nuisance, rainfall runoff, and leachate must be controlled. Requires controlled operations to insure destruction of pathogens present in sludge.
TECHNOLOGICAL	The composting technology is proven for conversion of organic material. Composting technology is not complex.	Removal of pieces of plastic and glass shards from waste is preferable to ensure quality of the finished compost.
IMPLEMENTABILITY	Vegetative composting appears easy to implement on a local basis for local consumption.	Acceptance by farmers of refuse-derived compost is problematical. Repeat compost markets are limited; market and usage are not constant.

CONCLUSION
Composting has the potential of reducing landfill space requirements, yields a beneficial soil amendment, and is easily implementable; however, impediments in developing composting as a practical alternative exist in the level of control required to produce a safe quality product, lack of constant markets, and resistance to use of composts produced from municipal refuse.

METHOD: Source Separation
Waste materials to be recovered (metal, glass, paper, etc.) are separated at the point of generation (household, office, etc.) for collection.

	PRO	CON
ECONOMIC	Little or no processing required to produce marketable material. Permits use of systems for handling low volumes of materials at each collection point with a very high yield at the central collection depot.	Increased labor and collection equipment is required if participation exceeds 20 percent. Profits are very vulnerable to market fluctuations and (except for paper) to container legislation. Major profit taking occurs at the central collection depot.
ENVIRONMENTAL	Increased education of the public, reduced consumption of virgin materials, and reduction of energy required through use of recycled materials. Can reduce landfill requirements for municipal refuse by an estimated 20 percent maximum assuming 100 percent participation and 100 percent retrieval efficiency.	Collection at many separate sites increases energy consumption. Data available indicate that the participation required to significantly reduce landfill requirements will be very difficult to achieve and sustain.
TECHNOLOGICAL	No new technology required for single family or commercial pickup.	Multi-family residential technique still developing.
IMPLEMENTABILITY	Has been implemented commercially for many years on specific items such as corrugated paper. Can be implemented immediately in some localities. Can be implemented with little capital investment.	Large scale implementation has not been achieved. Data on costs and market impacts are unreliable. Volumes and revenue are vulnerable to changes in participant behavior.

CONCLUSION
Source separation increases public awareness of the solid waste problem and has the potential to reduce projected increases in waste generation and requirements for processing facilities. This is the only system theoretically capable of achieving a 25 percent reduction in landfilled waste in the near future, but only by participation that has not been achieved anywhere on a large scale.

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METHOD: Mechanical Separation and Production of Refuse-Derived Fuel

The municipal waste stream has a significant glass, metal, and energy content. These wastes can be mechanically separated into usable or salable products through combinations of devices called "front-end" systems. Waste materials that have been shredded and air classified can be used in conversion processes to create energy, chemicals, or compost. These conversion processes are called "back-end" systems. A densified RDF (dRDF) that is more easily transported and stored can be produced through pelletizing or chemical modification but at additional expense.

	PRO	CON
ECONOMIC	The system can be customized for specific markets. Magnetic ferrous separation is economical in some areas.	Substantial operating costs are involved. Produces more contaminated materials than source separation, hence affecting market value. Usually more expensive than direct haul to presently available landfill.
ENVIRONMENTAL	Permits conversion or reclamation of up to 80 percent of the municipal waste stream. Shredding of wastes reduces landfill acreage and cover requirements by up to about 30 percent.	Requires mitigation measures to control air, noise, or water pollution at processing facilities. Disposal requirements for residual materials not well known.
TECHNOLOGICAL	Mechanical facilities can handle the large quantities of waste generated. Shredding and magnetic separation are fully developed operations.	Shredders require extensive servicing. RDF, unless densified, is difficult to store and handle. Densified RDF (pellets, dried and powdered) adds significant cost and has not been adequately tested for economic benefits in a large scale operation.
IMPLEMENTABILITY	Facility can be developed in stages as markets develop and as conversion processes are defined.	Runs risk of needing redesign as markets change.

CONCLUSION

Mechanical separation can remove some materials from the waste stream but valuable products still remain to be reclaimed. Materials removal and size reduction will make landfill operation easier. Production of RDF for use in existing facilities is the most economical alternative but currently has a very limited market. Introduction of coal-fired facilities or new facilities with ash-handling capabilities are needed to make the production of RDF an attractive alternative on a large scale.

METHOD: Direct Combustion

The energy in wastes may be recovered by directly firing all or part of the wastes independently or with fossil fuels (co-combustion). Raw refuse can be fired in boilers designed for that purpose. Refuse-Derived Fuel (RDF) produced by shredding and air classification can be burned in boilers with ash handling capabilities such as those fueled with coal or wood waste.

	PRO	CON
ECONOMIC	Minimal cost for energy conversion if existing boilers or cement kilns are available ($4-7 per ton net costs). Production of steam could have large potential market (yet to be documented).	Usage in California requires new or extensively modified boilers. Competes with low-cost coal if boiler has ash-handling capability. Steam quality is lower than optimum for electrical power generation.
ENVIRONMENTAL	Landfill requirement reduced 70-90 percent, depending on process. Energy recovered is greater than processing requirements. Could supplement use of increasingly scarce fossil fuels.	Air emissions are still under investigation but system may have more difficulty with air quality impact regulations than with emission standards. Best management of residues under development.
TECHNOLOGICAL	Well developed in Europe and being demonstrated in the United States. Many small sized systems have been installed in Eastern United States. Steam recovery equipment is similar to proven solid fuel fired boilers using wood waste and coal.	The ability to control air emissions in accordance with California standards is a problem that is expected to be controllable but probably at considerable expense. Use in cement kilns adequately demonstrated but site specific and expensive at best.
IMPLEMENTABILITY	Steam energy source welcomed by industry.	Air pollution regulations are constantly being tightened. Requires assured supplies of waste.

CONCLUSION

Direct combustion is attractive from an economical point of view. However, severe implementation problems exist due to environmental pollution controls. Further evaluation is required in terms of capital and operating costs, corrosion hazards, reliability, residue, and environmental impacts.

METHOD: Pyrolysis

The destructive distillation of organic wastes in an oxygen deficient atmosphere is called pyrolysis. Two full scale systems (200 TPD) have been built and operated. One system used pure oxygen and produced a 370 BTU/SCF gas that can be transported but is not being actively marketed at this time. The other system uses preheated air and produces a 100 BTU/SCF gas that is not transportable and is used directly in a boiler. Smaller systems have been developed and operated with some success, but there is no commercialization at this time. Gas production appears the simplest and most likely development and is discussed below.

	PRO	CON
ECONOMIC	There is a large demand for the gas produced since it can be substituted for natural gas in industry with minimum modification. The gas produced may possibly be converted into high value hydrogen, methanol, methane, or ammonia (some are readily transported and all are derived almost exclusively from natural gas). Has the least net cost of all options examined when implemented in large scale and used for high value chemical feedstock products. Can supplement costly fossil fuels.	Capital intensity plus high operating costs make this an expensive energy option. Market analysis for high value products is not complete due to complexity. The gas is not economically storable. Lower cost systems may evolve, especially from coal gasification technology.
ENVIRONMENTAL	No major air pollution problems expected. Further testing is planned. Reduces volume of landfill requirements by 80-95 percent. Slagging system produces totally inert residue. Energy recovered is greater than processing requirements.	System waste water discharges requires extensive treatment. Gas produced is toxic and unsuitable for domestic use. Conversion efficiency is lower than direct combustion.
TECHNOLOGICAL	Combustion of gas (such as boilers) is state-of-the-art; conversion to chemicals may have unquantified development.	Conversion of the gas to high value products has not been demonstrated. Use of the system in a large scale operation has not been demonstrated.
IMPLEMENTABILITY	The high marketable products may attract financing. Market for gas is available. Equitable distribution of benefits is achieved by conserving natural gas for residential use.	Capital intensity and high operating cost mandates assured waste flow and product utilization. Requires large systems for economy and large quantities of dilution water for sewage treatment.

CONCLUSION

Pyrolysis appears to be the best potential alternative environmentally, and may become economically competitive with direct combustion as fuel prices and availability change. However, limited knowledge of present markets requires further analysis to verify the economic viability of producing the high value products and to determine an optimum product mix.

CALIFORNIA STATE RESOURCE AGENCY
MATERIALS FOR CLASSROOM TEACHERS

FOR USE IN TEACHING ABOUT
THE NATURAL ENVIRONMENT

Title: **Be Careful with Our Stately Treasures**
Description: A colorful poster showing each state's tree (limited printing).
Topic: Plants
Grade Level: 4-6
Agency: State Department of Forestry

Title: **Don't Join the Bucket Brigade, Leave Tide Pool Life Alone!**
Description: Poster; good for elementary and adult.
Topic: Ocean life
Grade Level: K-12
Agency: State Department of Fish and Game and the University of California Sea Grant Program

Title: **Endangered Wildlife of California**
Description: A timely booklet, well illustrated, describing endangered wildlife in California. It also lists rare and extinct species in California as well as a federal list of California endangered species.
Topic: Endangered species
Grade Level: K-12
Agency: State Department of Fish and Game

Title: **Fish, Wildlife, and Plant Species in California Designated Endangered or Rare**
Description: A listing of species rare or endangered in California.
Topic: Endangered species
Grade Level: 6-12
Agency: State Department of Fish and Game

Title: **Geology of Placer Deposits**
Description: A booklet detailing methods and techniques which can be useful in discovering gold-bearing placer deposits.
Topic: Geology
Grade Level: 10-12
Agency: State Department of Conservation

Title: **Marine Mammals of California**
Description: This booklet begins with a comprehensive description of the various modifications of marine animals and of the Order Letacea. Whaling and whale conservation, and the Marine Mammal Protection Act are also explained. The bulk of the publication illustrates and describes 34 of the marine mammals seen or identified near California.
Topic: Marine mammals
Grade Level: 6-12
Agency: State Department of Fish and Game and the University of California Sea Grant Program

Title: **Species Booklets**
Description: A series of 12 booklets offer information on many California fish and game species as well as nongame species. All have photographs and/or drawings identifying species. Descriptions of habitat, natural history, and distribution are also included.
Topic: Wildlife
Grade Level: 4-12
Agency: State Department of Fish and Game

Title: **The California Gray Whale**
Description: A brochure with excellent color photographs. Content covers biology of the gray whale, the migration, endangered status, and guidelines for whale watching.
Topic: Gray whale
Grade Level: 4-12
Agency: State Department of Fish and Game

Title: **Thanks to You We Still Have a Home**
Description: A colorful poster showing a variety of birds on vegetation representative of their environment (limited printing).
Topic: Animals/birds
Grade Level: K-6
Agency: State Department of Forestry

Title: **The Plants and Animals of Folsom Lake**
Description: A detailed guide to the diverse natural communities surroundig Folsom Lake State Recreational area.
Topic: Plants and animals
Grade Level: 10-12
Agency: State Department of Parks and Recreation

Title: **Wildlife Leaflets**
Description: Excellent one-page leaflets, each dealing with a single species of wildlife. Almost all familiar vertebrates are described.
Topic: Wildlife
Grade Level: 4-12
Agency: State Department of Fish and Game

Title: **Wildlife—The Environmental Barometer**
Description: A pamphlet detailing the importance of a healthy environment for wildlife and the potential harm of man-made changes. Details harmful changes caused by man which may affect all of life, including man. "By saving wildlife man may save himself."
Topic: Wildlife
Grade Level: 4-12
Agency: State Department of Fish and Game

FOR USE IN TEACHING ABOUT THE BUILT ENVIRONMENT

Title: **A Description of the Set of Minerals and Rocks Furnished to California Schools by the California Division of Mines and Geology**
Description: A pamphlet filled with photographs and excellent chemical descriptions of minerals as well as a discussion of their economic worth and where they can be found in California.
Topic: Geology
Grade Level: 4-12
Agency: State Department of Conservation

Title: **Simplified Geologic Map of California**
Description: A postcard to commemorate the state centennial. Color coded to indicate age and rock type.
Topic: Geology
Grade Level: 4-12
Agency: State Department of Conservation

FOR USE IN TEACHING ABOUT SOCIAL INSTITUTIONS AND DECISION MAKING

Title: **Adventures in Public Transit**
Description: The learning activities are geared to Orange County but the format could be used elsewhere. The activities are approached as a "magic window experience" with firsthand observations to see, do, record, evaluate, and value.
Topic: Transportation
Grade Level: 6-8
Agency: State Department of Transportation

Title: **Checklist for You and the Environment**
Description: This brochure sets forth simple, everyday methods by which all Californians can reduce waste.
Topic: Waste reduction
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Closing the Loop***
Description: This filmstrip describes the "hows" and "whys" of recycling.
Topic: Recycling
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Composting**
Description: This slide show describes the process which diverts organic wastes from landfills and yields a rich soil amendment.
Topic: Composting
Grade Level: 7-12
Agency: Solid Waste Management Board

*Filmstrips also available as slide shows

Title: **The Davis Experience**
Description: A reprint from *Solar Age* (May 1978) describing the Davis energy study, their energy building code, and city planning strategies that maximize the use of solar energy.
Topic: Solar energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Estimating Utilities' Prices for Power Purchases from Alternative Energy Resources**
Description: A technical report that estimates the future costs of conventional energy resources so that cost comparisons with renewable and decentralized energy resources can be made in a more economically competitive manner. The information presented is an interesting case study of the role of the economic forecasting in present energy investment decisions. Includes data on California's electricity supply by fuel type and estimated costs of generating electricity with a variety of fuel types.
Topic: Energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Fact Sheets** (single items available for reproduction)
Description: A series of information bulletins covering a wide range of solid waste management topics: waste reduction, oil recyling, recycling, composting, the Solid Waste Management Board, waste to energy, glossary of solid waste management terms, citizen action for a waste-efficient California.
Topic: Waste management
Grade Level: 10-12
Agency: Solid Waste Management Board

Title: **The Garbage Crisis** (teacher background information)
Description: This brochure gives overview of the Solid Waste Management Board's activities statewide for 1980.
Topic: Waste management
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Great American Wild Waste Show**
Description: Videotaped vaudeville performance by the Twelfth Night Repertory Company. Teaches four "R's" of solid waste management—reduce, reuse, recycle, recover.
Topic: Waste management
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Industry Recycles***
Description: This filmstrip describes current methods of recycling employed within various California industries.
Topic: Recycling
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Joint Investigation by the California Energy Commission and the California Public Utilities Commission into the Availability and Potential Use of Solar Energy in California**
Description: A technical report that outlines the desirability of using solar energy for domestic water heating and passive space heating. Useful as a benchmark in studying the history of solar-related legislation in California. Recommendations for incentives utilities can use to motivate their customers to use solar energy are outlined. This publication can be used as a checklist of the progress made by the utilities in carrying out the recommendations listed.
Topic: Energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Passive Solar Design—Here and Now**
Description: Details and pictures various architectural designs which promote the collection, storage, and use of solar energy. Explores historical ways passive solar energy was used by the Greeks and Romans, the Mesa Verde Indians, and the residents of New England. Good discussion of the various ways that heat moves. Illustrates the effectiveness of passive systems and the importance of energy conservation.
Topic: Solar energy
Grade Level: 6-12
Agency: California Energy Commission

Title: **Salvaging Demolition Waste**
Description: This slide show details innovative reuse and recycling of construction and demolition debris.
Topic: Salvaging
Grade Level: 6-12
Agency: Solid Waste Management Board

Title: **Saving Energy at Home—It's Your Money**
Description: Pamphlet illustrating how energy can be conserved at home.
Topic: Energy conservation
Grade Level: 6-12
Agency: California Energy Commission

*Filmstrips also available as slide shows

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Title: **Solar Water Heaters in California 1891-1930**

Description: A magazine-type publication describing the use of solar energy to heat water. The technology is not as new as some people imagine.

Topic: Solar energy

Grade Level: 6-12

Agency: California Energy Commission

Title: **Solid Waste Management Resource Persons** (for large assembly presentations)

Description: Speakers available for presentations on variety of solid waste management topics: State Solid Waste Management Board, duties and functions; California's garbage crisis, controlling litter, waste reduction, resource recovery, recycling, salvaging and demolition wastes, and composting.

Topic: Waste management

Grade Level: 7-12

Agency: Solid Waste Management Board

Title: **Solid Waste Posters**

Description: Set of seven colorful posters depicting the good, bad, hilarious and silly ways in which we operate and simple "do-able" ways for us to change for the better: "Great Garbage Machine," "Technology!" "Why Recycle!" "Buyer Be-Aware!" "Recycling Is for Everyone!" "Running Out/Running Over!" "Garbage Is What You Throw Away!"

Topic: Waste management

Grade Level: 7-12

Agency: Solid Waste Management Board

Title: **State Solid Waste Management Board**

Description: This slide show gives an overview of California's Solid Waste Management Board membership, history, and functions.

Topic: Waste management

Grade Level: 7-12

Agency: Solid Waste Management Board

Title: **Transportation Alternatives—Student Handbook**

Description: A booklet which presents the modes of transportation. It can be used at home to do a self-transportation survey along with family involvement.

Topic: Transportation

Grade Level: 3-7

Agency: State Department of Transportation

Title: **Trash Monster**

Description: Interdisciplinary, two-week environmental education unit. Teaches students resource conservation skills. Complete sets of materials and procedures provided.

Topic: Waste management

Grade Level: 5-7

Agency: Solid Waste Management Board

Title: **Waste Reduction—A Consumer Action**

Description: This slide show is an examination of consumption/throw-away habits and simple, everyday measures to combat waste.

Topic: Waste reduction

Grade Level: 7-12

Agency: Solid Waste Management Board

Title: **Waste-To-Energy***
Description: This filmstrip describes the evolving technology of waste utilization as a resource to fill California's growing energy needs.
Topic: Energy
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Wildlife—The Environmental Barometer**
Description: A brochure describing how wildlife can be used to assess the health of the environment.
Topic: Wildlife
Grade Level: 10-12
Agency: State Department of Fish and Game

Title: **Wizard of Waste**
Description: An interdisciplinary, two-week environmental education unit. Teaches students resource conservation skills. Complete sets of materials and procedures provided.
Topic: Waste management
Grade Level: 2-4
Agency: Solid Waste Management Board

*Filmstrips also available as slide shows

FOR USE IN TEACHING ABOUT RESOURCE MANAGEMENT

Title: **A Guide to the Urban Water Conservation Garden**
Description: This brochure gives valuable information for planting a variety of gardens (rock gardens, shrub beds, vegetable gardens, etc.) on one side; the other side is a poster of a model garden.
Topic: Water conservation
Grade Level: K-12
Agency: Department of Water Resources

Title: **An Introduction to the Energy Resources of California**
Description: A comprehensive "primer" on nonrenewable energy resources: oil gas, and geothermal. It includes a description of the geology of petroleum deposits and the various steps needed to produce oil from drilling to refining. A fold-out map of California shows the known petroleum and geothermal deposits.
Topic: Petroleum/Energy/Geology
Grade Level: 10-12
Agency: State Department of Conservation

Title: **A Pilot Water Conservation Program**
Description: A 1978 publication describing the Department of Water Resources public outreach program on water conservation during the drought. Specific water conserving devices and habits are outlined and the public's response to implementing water conservation strategies is discussed.
Topic: Water conservation
Grade Level: 7-12
Agency: State Department of Water Resources

Topic: **California Solar Information Packet**
Description: A pamphlet illustrating basic solar design principles, passive solar applications, and active solar systems.
Topic: Solar energy
Grade Level: 7-12
Agency: State Energy Commission

Title: **Decade of the Sun. Program for Maximum Implementation of Solar Energy through 1990**
Description: An excellent overview of California's Solar Program present and future, a review of the state-of-the-art of various solar technologies, potential electric energy savings with solar.
Topic: Energy/Solar
Grade Level: 10-12
Agency: California Energy Commission

Title: **Domestic Solar Water Heating—A Builder's Guide**
Description: A pamphlet describing the basic components of a solar domestic water heating system with illustrations.
Topic: Solar energy
Grade Level: 6-12
Agency: California Energy Commission

Title: **Energy Farming**
Description: A study of plant crops which could be used as a biomass for fuel. Economics of energy farming is discussed in conjunction with varied energy conversion routes and products from biomass.
Topic: Energy
Grade Level: 10-12
Agency: California Energy Commission

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Title: **Environmental Impact Report for California Energy Commission Solar and Wind Programs**
Description: An excellent overview of the state's wind and solar programs describing the technologies, their impacts on air and water quality, and the potential of the resource for displacing nonrenewable energy resources.
Topic: Energy/Wind
Grade Level: 10-12
Agency: California Energy Commission

Title: **Excerpts from State Fire Laws Applicable to Forest Fire Prevention**
Description: A small pamphlet describing the fire permit process, techniques for fire hazard reduction, and penalties and liabilities related to behavior during forest fires.
Topic: Forest fires
Grade Level: 7-12
Agency: State Department of Forestry

Title: **Fire Hazard Reduction**
Description: A one-page handout diagramming the techniques for reducing fire hazards around a forest dwelling, as well as plans for building a chimney spark arrester.
Topic: Fire protection
Grade Level: 7-12
Agency: State Department of Forestry

Title: **Fireproof Your Forest Home**
Description: A small brochure with photographs showing how to clear the area around a structure to help prevent it from burning in case of a forest fire.
Topic: Fire prevention
Grade Level: 4-6
Agency: State Department of Forestry

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Title: **Fire. Will Your Home be Next?**
Description: Pamphlet describing steps to take to reduce fire hazards to a structure by 70 percent.
Topic: Fire prevention
Grade Level: 7-12
Agency: State Depatment of Forestry

Title: **Handbook on California Natural Resources**
Description: An informational guide to the development and maintenance of programs in natural resource use and conservation. Good basic information on soil, water, minerals, air, plant, and animal life.
Topic: Natural resources
Grade Level: 8-12
Agency: State Department of Conservation

Title: **Hints for Water Conservation**
Description: An information bulletin outlining home water conservation strategies.
Topic: Water conservation
Grade: 4-6
Agency: State Department of Water Resources

Title: **Impact of Severe Drought in Marin County, California**
Description: A 1979 publication that outlines the effects of water shortage on residences, businesses, and livestock ranches. Contains many figures and tables of water use data. A good case study for secondary use.
Topic: Drought
Grade Level: 7-12
Agency: State Department of Water Resources

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Title: **Joint Investigation by the California Energy Commission and the California Public Utilities Commission into the Availability and Potential Use of Solar Energy in California**
Description: A technical report that outlines the desirability of using solar energy for domestic water heating and passive space heating. Useful as a benchmark in studying the history of solar-related legislation in California. Recommendations for incentives utilities can use to motivate their customers to use solar energy are outlined. This publication can be used as a checklist of the progress made by the utilities in carrying out the recommendations listed.
Topic: Energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Save Energy**
Description: A survey of current activities in energy management of local, statewide, and national significance. Articles highlight CEES activities of local community groups, grant and utility programs, local government options, and state agencies working in energy. Each issue usually contains a policy piece and reproducible reference feature.
Topic: Energy management programs and policy
Grade Level: Designed for decision makers. Would be useful in high school as well.
Agency: California Energy Extension Service

Title: **Save Water**
Description: A graphically pleasing brochure outlining water conservation techniques. A good succinct introduction for use at all levels, including primary.
Topic: Water conservation
Grade Level: K-12
Agency: State Department of Water Resources

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Title: **Solar Here and Now**

Description: A pamphlet detailing active and passive heating techniques.

Topic: Solar energy

Grade Level: 6-12

Agency: California Energy Commission

Title: **Solar Installers Training Manual**

Description: Over 200-page curriculum of domestic hot water systems, pool systems, and space heating systems. Manual is accurate, complete, and extremely practical and is currently used in over 15 training programs.

Topic: Training for solar installers

Grade Level: High school

Agency: SolarWork Institute, California Energy Extension Services (CEES)

Title: **Solar Pool Heating**

Description: A pamphlet illustrating how solar heats pool water and how the water cools off. Pool covers are discussed along with other ways heat may be conserved. Good information on collectors, collector tilt and sizing, controls, mounting the collectors; maintenance and installation are also covered.

Topic: Solar energy

Grade Level: 7-12

Agency: California Energy Commission

Title: **Synthetic Oil vs. Methanol as a Liquid Fuel Product from Waste Conversion Processes**

Description: A technical report describing the processes by which municipal, agricultural, and forestry wastes can be converted into ethanol or methanol, and a discussion of the ways ethanol and methanol can be used to substitute for gasoline, natural gas, or diesel oil in combustion turbines for generating electricity as fuel for automobiles and as a fuel for boilers.

Topic: Energy from municipal, agricultural, and forest wastes

Grade Level: 10-12

Agency: California Energy Commission

Title: **The LNG Decision in California: Reliability, Cost, Safety, and Siting**

Description: Good resource describing LNG world trade routes, facilities, and terminals with numerous charts and tables relating to LNG cost, safety, and siting.

Topic: Energy/LNG

Grade Level: 10-12

Agency: California Energy Commission

Title: **Urban Forestry**

Description: A four-page pamphlet dealing with planting trees in urban areas. Urban forestry projects are described which could be duplicated by a class.

Topic: Trees

Grade Level: K-12

Agency: State Department of Forestry

Title: **Water Conservation in California**

Description: A 1976 publication describing water uses in California. Water conservation strategies for residences, businesses, and agriculture are outlined. Many figures and tables are included.

Topic: Water

Grade Level: 7-12

Agency: State Department of Water Resources

Title:	**Water Pricing**
Description:	An information bulletin describing water pricing strategies that can encourage water conservation.
Topic:	Water conservation
Grade Level:	10-12
Agency:	State Department of Water Resources

Title:	**Water Saving Planting Ideas** (reprinted from *Sunset* magazine)
Description:	An informative article describing drought-tolerant or drought-resistant plants for California gardens.
Topic:	Water conservation
Grade Level:	7-12
Agency:	Department of Water Resource

Title:	**Wind-Electric Power, A Renewable Energy Resource for California**
Description:	An overview of the use of wind in California to generate electricity. Includes a map of high-wind areas in the state and a summary of the California wind program through 1978. (This can be updated with more current information from the ECE Wind Office.)
Topic:	Energy/Wind-Electricity
Grade Level:	10-12
Agency:	California Energy Commission

RESIDENT OUTDOOR EDUCATION

Resident outdoor education programs are based on three ingredients for effective learning: a specific body of content, firsthand experience, and personal identification with the affective goals of the program. As the name implies, outdoor education takes place outdoors in the natural environment. The setting is a laboratory where firsthand observations provide the examples that lead to discovering and confirming the scientific principles on which the program is based. Personal verification of facts, principles, and aesthetic appreciation is at the core of every learning experience. Since the environment is teacher and textbook, the group leader is free to act as a resource person and carry on a dialogue with students, exchanging observations and ideas, making generalizations based on multiple observations, and expressing the feelings and appreciation that a close study of the natural environment evokes.

Outdoor settings are generally crowded with interesting things to observe and think about. Students are easily involved with the content of the setting. This makes it possible for the leader to move easily from working with individuals, to small groups, or the total group. Independence and personal responsibility are emphasized in making observations, initiating dialogues, exchanging ideas, and assuming responsibility for learning.

The natural environment is an optimal setting for developing positive attitudes about the relationship of self to the environment. Examples of cause and effect relationships are available everywhere. There is immediate feedback on the consequences of human action on the environment. Within this context, students can develop a sense of personal responsibility in caring for the environment.

Recognition of the inherent beauty in an outdoor setting brings a richness to our lives that is beyond words. The multitude of living things—plants and animals—in the natural environment can be used to build a respect for the preciousness of life. The variety of forms living in harmony and for mutual benefit in a small area of the environment are representative of the principles that govern all of nature.

California public schools are fortunate to have access to a variety of resident outdoor school programs. Because these programs are an integral part of environmental education, a directory of city and county programs follows:

City and County Resident Outdoor Education Programs

Fresno County
Chuck Kaylor
Regional Learning Center
Route 3, Box 530
Sonora, CA 95370
(209) 532-3691

Glenn County
Ralph Herman
525 West Sycamore
Willows, CA 95988
(916) 934-7011

Humboldt County
Cheryl Christiansen
901 Myrtle Avenue
Eureka, CA 95501
(707) 445-7611

Kern County
Ben Bird
5801 Sundale Avenue
Bakersfield, CA 93309
(805) 834-3700

Lake County
Gerald DeFries
P.O. Box 457
Boonville, CA 95433

Los Angeles Unified
Durrell Maughan
3317 Bellevue Avenue
Los Angeles, CA 90026
(213) 625-6000

Los Angeles County
9300 East Imperial Hwy.
Downey, CA 90242
(213) 922-6334

Long Beach Unified
701 Locust Avenue
Long Beach, CA 90813
(213) 436-9931

Marin County
1111 Las Galinas Avenue
San Rafael, CA 94903
(415) 472-4110

Monterey County
J. P. Van Ettinger
P.O. Box 851
Salinas, CA 93901
(408) 424-0654

Orange County
P.O. Box 15029
Santa Ana, CA 95705
(714) 953-3900

Sacramento County
Glenn Davis
5600 Sly Park Road
Pollack Pines, CA 95726
(916) 366-2718

San Francisco City & County
Lynette Porteous
135 Van Ness Avenue
San Francisco, CA 94102
(415) 505-9000

San Joaquin County
22 East Weber Avenue
Stockton, CA 95202
(209) 944-2394

San Luis Obispo County
Jim Barlow
2156 Sierra Way
San Luis Obispo, CA 93401
(805) 544-3288

San Mateo County
Glendon McFate
333 Main Street
Redwood City, CA 94063
(415) 364-5600

Santa Barbara County
Paul Jillson
4400 Cathedral Oaks Road
Santa Barbara, CA 93111
(805) 964-4711

Santa Clara County
Carl Miescke
100 Skyport Drive
San Jose, CA 95110
(408) 299-2374

Santa Cruz County
Dr. Jeanne Hubert
701 Ocean Street
Santa Cruz, CA 95060
(408) 425-2001

Shasta County
Brian Swagerty
1644 Magnolia
Redding, CA 96002
(916) 244-4600

Siskiyou County
Larry Wehmeyer
609 Gold Street
Yreka, CA 96097
(916) 842-5751

Sutter County
Jack Murtha
463 Second Street
Yuba City, CA 95991
(916) 673-6110

Tulare County
James Vidak
County Civic Center
Visalia, CA 93277
(209) 733-6386